Fossilium Catalogus

II: Plantae.

Editus a

W. Jongmans.

Pars 19:

J. Groves

Charophyta.

W. Junk
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Introduction.

In compiling the portion of the International Catalogue relating to the small group of Charophyta, the writer is fully aware that such a record, from the very imperfect nature of the remains preserved cannot be a satisfactory one. In almost all cases the remains of these plants consist only of imperfect detached fruits and minute fragments of stems and branchlets.

STRUCTURE OF FRUIT OF CHAROPHYTA.

The fruit of a Charophyte (an oogonium) consists of:

(1) A sac composed of cylindrical cells coiled spirally, known as „spiral-cells".

(2) The coronula, a small organ composed of five, or ten cells which have been at a very early stage cut off by transverse septa from the apex of the spiral-cells.

(3) A usually short cell, called the „stalk-cell", inserted at the base of the oogonium and by which the fruit is attached to the branchlet.

(4) A more or less ellipsoid body, the oosphere, occupying the centre cavity of the oogonium, and, after fertilization, becoming the oospore, with a thickened exterior wall having spiral ridges corresponding with the sutures of the enveloping spiral-cells.

In living species, while in many cases the spiral-cells readily take up carbonate of lime from the water, the coronula and the stalk-cell never do this. In the fossil remains, the petrified spiral-cells, or casts of them, are usually present, occasionally also the oospore, but neither the coronula nor the stalk-cell has so far been found, due no doubt to a similar circumstance.

A few authors have taken the swollen tips of the spiral-cells occuring in some of the fossil fruits, as representing a coronula; a certain shrinkage of the neck just below the tips, giving an impression of the latter being separate cells, has favoured this illusion. In living species, which have similar swollen tips to the spiral-cells, a like shrinkage is observable in dried examples.

DIFFICULTY OF CLASSIFYING FOSSIL TYPES.

In the living representatives of the group, the structure of the coronula affords the principal character for separating them into the two main divisions, Chareae and Nitelleae, that organ in the former consisting of five cells in one tier, in the latter of ten cells in two tiers.

From the absence of the coronula there is therefore, at the outset, an obstacle in the way of allotting fossil fruits to either of the large

existing groups. The fact too that, except in the two distinct fossil types, Clavator and Lagynophora, the fruits are never found attached to the vegetative parts, increases the difficulty of classification, as the position of the fruits affords a useful taxonomic character.

Except in a very few cases, no-one would venture to identify a living species of Charophyte from imperfect detached fruits alone, yet in the case of the fossils that is all the evidence usually available.

When the fossil fruits are found in any considerable numbers, more than one type is almost always present, so that if associated with vegetative remains, it is not possible with any degree of certainty to identify the latter with either type of fruit.

SIZE AND SHAPE OF FOSSIL FRUITS.

The range of size in the different types of Charophyte fruit is very great. The smallest on record appears to be that of a species of Tolypella from the Oligocene, 275—300 μ long, 200—250 μ broad, the largest a Kosmogyra from the Liburnian (Lowest Tertiary), the measurements of which are given as 1800—2000 μ long, 1600 μ broad. In no living species with a terete oogonium are the fruits quite as small as that of the Tolypella mentioned, nor in any living species any so large as the Kosmogyra.

Size alone as a distinctive character is not very reliable. Where fruits are found in considerable numbers closely resembling one another and differing in size alone, with every gradation between the largest and the smallest, it can only be concluded that they belong to the same species. When on the other hand one can readily sort similar fruits into two or more sizes without intermediates, it may be fairly assumed that they belong to different types. In the case of similar fruits, but of different sizes, being found in different localities or at different horizons, it can only be a matter of surmise whether they belong to the same or different species.

In shape also the fossil fruits present a very wide range: in Chara compressa they are described as distinctly broader than long; in many species they are practically spherical; while in most they are longer than broad, ellipsoid, ovoid, obovoid, subcylindrical or cylindrical. Among living representatives of the group none has the fruits broader than long, but the other types are met with. In Lagynophora we have an entirely different form of fruit, the flask-shaped, the lower portion being almost globular, the upper cylindrical. This form is also present in an undescribed type from the Middle Purbeck Beds. A fruit in which the Oogonium is enclosed in an outer envelope is apparently peculiar to the genus Clavator.

PROBABLE GENERA OF FOSSIL REMAINS.

In view of the close resemblance in size and shape of some of the types of fossil fruit with the fruits of living species of the genus Chara, such types may reasonably be assigned to that genus.

Some of the fossil types, on the other hand, clearly do not belong to Chara, notably the large spherical type of the Upper Eocene and Oligocene Beds, of which C. medicaginula may be taken as the type. The nearest to this of any living Charophyte is to be found in Tolypella, a small genus belonging to the division Nitelleae. In the case of C. medicaginula some authors consider that certain vegetative remains found in company with the fruits belong to that species. If they are correct in this assumption, it would indicate an important difference from the living representatives of

Tolypella, in that the fossil stems in question are corticate, whereas in all existing Nitelleae the stems are ecorticate.

The large ellipsoidal fossil fruits, of which C. helicteres may be taken as the type, show some resemblance to the single species of the living genus Lychnothamnus, which has a corticate stem.

Except in very late deposits where the fruits are evidently those of common living species of Nitella the longitudinally-flattened form of fruit is not found among the fossil types. In living species of Nitella the spiral-cells do not absorb lime and it is no doubt due to a similar lack of calcification that the genus is not represented in earlier beds. It is inconceivable that the large and very complicated genus Nitella, the members of which are distributed all over the world, has been evolved since Miocene times.

SPIRAL-CELLS AND BASAL ORIFICE.

The spiral-cells of the oogonium afford the outstanding character distinguishing the fruits of the Charophyta from those of any other group of plants.

The spiral-cells of all living Charophytes are normally five in number, and this is the case in all fossil types which can with confidence be referred to the group, with the exception of the very earliest, Palaeochara, in which there are six.

In all known living species and in all the fossil specimens which, in the opinion of the present writer, can be safely attributed to the group, the spiral-cells are sinistrally coiled, that is in the reverse direction to the thread of an ordinary screw; unfortunately in a number of figures of the fruits of both living and fossil Charophytes the coil is represented as dextral, either through the carelessness of the artist or through reversal in the process of reproduction. In the organisms from the Devonian formation which have been attributed to the Charophyta the coil is dextral, — a strong argument against their belonging to the group.

The degree of torsion of the spiral-cells varies greatly in different species, and, in consequence the number of convolutions visible from one side differs considerably. Within limits, the number of convolutions visible seems fairly constant in each species, and much importance has been attached to this as a character to distinguish the fossil types. It is not, however, entirely reliable as individual specimens will often be found with a greater or less number than usual. For instance Dollfus & Fritel give a range of 7 to 11 for their species Chara elegans.

The size and shape of the orifice at the base of the fruit in which the stalk-cell was inserted, appears to vary to some extent in the different fossil types, and may possibly afford a character to separate them, but this has been described or figured in comparatively few cases.

ANTHERIDIA.

In no case apparently have the male organs of the Charophyta (antheridia), or any portion of them, been found in the fossil state. Considering their extremely delicate structure, this is not a matter for surprise.

VEGETATIVE PARTS.

In most of the deposits in which remains of Charophytes are found either no vegetative parts are preserved or they are of such a fragmentary condition as usually to afford little clue to the geeneral structure of the plants.

In transverse sections of the stem, when alternate cells differ in diameter it is evident that the cortex is diplostichous and when every third cell is thicker than the intermediate cells that it is triplostichous. When the cells are of the same diameter the number will afford presumptive evidence as to the class of cortex, for instance if as many as 18, it is probably triplostichous, (though it may be diplostichous) if less than 10 problably haplostichous.

Stem-nodes and stipulodes are rarely found, which is unfortunate as the number and disposition of the latter afford valuable classificatory characters. When stem-nodes are present the number of branchlets can usually be made out, from their bases. The remainder of the branchlet is usually only represented by minute detached fragments, sometimes, showing a node, sometimes the junction of the two series of cortical-cells. The apex is very rarely preserved.

In two formations only have fruits been found attached to the branchlets, the Middle Purbeck Beds (Jurassic), and the Liburnian (Early Tertiary). In the former case only a portion of the branchlet is preserved, while in the latter Lagynophora, alone, whole whorls of branchlets are present, affording unique evidence as to the structure and probable size of this remarkable plant.

From the remains preserved there is no reason to suppose that the stature to which members of the group attained was at any time much if at all larger than at present. The remains of Lagynophora indicate a much smaller plant than any existing Charophyte.

HABITAT AND INCRUSTATION.

The remains of Charophytes are found almost exclusively in fresh and brackish water deposits, implying habitats similar to those of the living representatives of the group. An exception occurs in the case of some oolitic beds, where small assemblages of fruits are found in company with marine organisms. The presence of remains in a marine deposit may perhaps be explained by the drifting out to sea from an estuary of tangles of the Charophytes, as not infrequent ly occurs with freshwater and land plants. Had the Charophyta been inhabitants of the sea at that time, their remains would almost certainly be found in many of the earlier marine formations.

Many living Charophyta, especially some belonging to the genus Chara, occur in immense quantity, and in dense masses, completely filling up the pieces of water in which they occur, to the temporary exclusion of other vegetation. In the course of a few years the whole colony will have died down, giving place to other plants, but in the case of those species, of which there are many, that take up a thick coating of Carbonate of Lime, they must leave behind a considerable limy deposit at the bottom of still water, in which they usually grow. There is little doubt that the presence of incrusted species occurring under similar conditions, in past ages, is responsible for many of the seams of so-called shell-limestone in Upper Tertiary Beds. In these deposits the fruits are found in great numbers, but the present writer is a little sceptical as regards Mantell's statement (1854), that the oogonia are ever so numerous as to „constitute a large proportion of the mass" of limestone blocks, though no doubt the latter are largely made up of the decayed vegetative parts of these plants. A French writer (Robert, 1871) has suggested the term „Characite" for limestone built up of the remains of Charophytes. It has been suggestesd (Wieland, 1914), that the grains of which certain ancient „oolitic" rock is composed may have originated from the oogonia of Charophyta, but this would surely imply the existence of these plants in quite incredible quantities.

PROGRESS OF KNOWLEDGE OF FOSSIL TYPES.

The first appearance in literature of fossil Charophyta would seem to have been in 1780, when Soldani figured an unmistakable Charophyte-fruit, which he imagined to be the shell of a mollusc. The artist added a narrow mouth to the figure of the supposed shell, to place its molluscan affinity beyond doubt!

According to Desmarest (1810) Dufourny de Villiers read a paper on the 18th. June 1785, before the Academy of Sciences, giving in considerable detail a description of some Charophyte fruits, under the name of „tourbillons ou vortex". This paper was never published but Desmarest evidently had access to it as he furnishes a lengthy quotation from it.

In 1804 Lamarck described, and in 1807 figured, the remarkably large spherical Charophyte fruit which abounds in the Tertiary Beds of the Paris Basin. This he styled „Gyrogonite", giving to it the name Gyrogonites medicaginula. Lamarck too regarded the organism as a molluscan shell, though with an element of doubt, drawing attention to its resemblance to the fruit of a species of Medicago, hence the specific name. During the next few years quite a considerable literature sprang up in France around the problematic organism. Leman (1812) was apparently the first to detect its real nature.

In 1822 Adolphe Brongniart gave to it the name of Chara medicaginula, at the same time describing two other species from the Paris Basin. In 1826 Lyell identified fruits, occurring in Oligocene Beds in the Isle of Wight, with C. medicaginula, and described from the same Beds a new type, C. tuberculata, characterised by the presence of external projections from the spiral-cells, at more or less regular intervals. The nature of these protuberances is still problematic, see remarks under genus Kosmogyra.

If they are parts of the spiral-cells they are not met with in any living representatives of the group.

In 1840 Sowerby described Charophyte fruits from some beds considered to be Upper Cretaceous, in a basaltic region in Central India, thus taking the group back to Mesozoic times.

In 1850 Unger, in Genera et Species Plantarum fossilium, enumerated 19 species, all from Cainozoic deposits; of these 13 were described as new. In this work Unger had the valuable assistance of Alexander Braun, the greatest authority on the Charophyta, to whom he ascribed most of the new species. From this time onward many new types, more or less distinctly characterised, have been described by Heer, Saporta, Ettingshausen, Andreae, Tuzson, Dollfus & Fritel, Reid & Groves, and others, but in most cases these do not represent any very important departures from the types comprised in Unger's work.

In 1860 Unger described a species from the Upper Cretaceous of Eastern Galicia; in 1865 Heer one from the Purbeckian of Switzerland. In 1869 Schimper, in Traité de Paléontologie Végétale, summarised the 39 species then known.

Guido Stache, after two short preliminary papers (1872 & 1880), produced in 1889 an elaborate and well-illustrated memoir on the fossil fauna and flora of the Liburnian Beds, a series of Beds occupying a very narrow area, north and south of Triest. In this he devoted a considerable space to the Charophyta, setting up a new genus, Kosmogyra, to include those having protuberances on the spiral-cells, taking Lyell's Chara tuberculata as the type, and describing several new species. He also described and figured a remarkable and entirely new genus, Lagynophora, of which he particularised five species. In addition he described several new species under

Chara, Nitella, Kosmogyrella, and Cristatella, the two latter newly constituted genera, each with one fossil species.

In 1873 Meek had referred to certain minute globular bodies, with spiral markings, found in a marine formation (Corniferous Limestone) of the Lower Devonian, at the Falls of the Ohio, which he concluded must be the fruits of a Chara. In 1880 Williamson described a very similar organism from Kelly's Island, Ohio, under a new provisional genus, Calcisphaera, as C. robusta, remarking that it was quite possibly animal, not vegetable, In 1883 Dawson renamed it Saccamina? (Calcisphaera) Eriana, considering it to be a Foraminifer. In 1886 Ulrich again described it under a new genus, Moellerina, as M. Greenei, also regarding it as a Foraminifer. In 1889 Knowlton, in a well-reasoned paper, discussed the arguments, which had been advanced by various naturalists of standing, for and against the conclusion that these organisms belonged to the Charophyta, leaving the matter sub judice, but giving the new name Calcisphaera Lemoni to the Falls of the Ohio specimens which he considered distinct. In 1906 Karpinski placed both of the Ohio organisms under the genus Trochiliscus, as T. Lemoni and T. robustus. In 1922 Bell again reviewed the whole matter, and summed up against their being charophytic, regarding the spirals merely as external markings, and not as the distinctive spiral-cells constituting the oogonium and enclosing the oospore, the very important outstanding character of the fruits of all known Charophyta.

In 1890 Wethered described and figured the stem of an entirely new type from the Purbeck Beds, (Jurassic) of Dorset, England. In 1916 Reid & Groves gave a description and figures of this, naming the new genus Clavator, and showing that it possessed important characteristics separaling it from any previously known Charophyta.

In 1909 Upton described the fruit of a species of Charophyte from the Lower Oolite Beds, carrying the group a little farther back.

In 1921 Kidston and Lang described and figured under the name of Algites (Palaeonitella) Cranii, some remarkable vegetative remains, from the Rhynie Chert Beds, Old Red Sandstone of Aberdeenshire, Scot Land, which suggest a possible affinity with the Charophyta, but in the absence of fruit it has not yet been possible to arrive at a conclusion on the matter.

In 1921 Reid and Groves described and figured two types of fruit from the Lower Headon Beds, (Eocene) of Hampshire (England), which they considered referable to the living genus Tolypella

In 1922 Bell announced the very important discovery of fruits of what seems to be an undoubted Charophyte, from the Coal Measures of Nova Scotia, This he described and figured under the name of Palaeochara acadica. The outstanding difference between this and any other Charophyte, living or fossil, is that the outer portion of the oogonium consists of six instead of five, spiral-cells.

In 1924 the present writer, in vol. 2 of British Charophyta, attempted a short sketch of the geological history of the group.

In 1927 Prof. Pia put forward a systematic arrangement of the genera and species of the group, reviving Lamarck's genus Gyrogonites, to include most of the fossil species which have been described under Chara. The genera he arranged as follows:

A. True Charophyta.

1. Characeae.
   a. Nitelleae. (Nitella, Ag., Tolypella, A. Braun).
   b. Chareae. (Tolypellopsis, Leonh. Chara, Vaill.).
   c. Lagynophoreae. (Lagynophora, Stache).

d. Hypothetical genera of fossil Charophytes. (Characeites, Pia. Gyrogonites, Lam. Kosmogyra, Stache. Kosmogyrella, Stache).

2. Palaeocharaceae.
   Palaeochara, Bell.
3. Clavatoraceae.
   Clavator, Reid & Groves.

B. **Doubtful Charophyta** (Fossil).
   Palaeonitella, Kidst. & Lang. Trochiliscus, Pand. Sycidium, Sandb.

It is to be regretted that some names have been given to fossil Charophyte remains without figure or description, and even when figures and descriptions are given the former are often too crude and the latter not sufficiently explicit for the purpose of identification.

My best thanks are due to my very good friend, Mr. W. N. Edwards, Deputy-Keeper of the Geological Departement of the British Museum, without whose ever-ready help and advice it would not have been possible for me to have compiled this catalogue. I am also much indebted to Messrs. W. H. Broadbent and F. M. Wonnacott of the same department — the former for frequent assistance in consulting the library of the department, the latter for kindly looking through and regularising the book references in the catalogue — to Prof. Julius Pia and Dr. C. D. Sherborn for help with references, and to Mr. B. H. Soulsby, late General Librarian of the Museum, Mr. J. Ardagh, Librarian of the Botanical Department, and the Librarians of the Royal, Linnean, and Geological Societies, for assistance in consulting the respective libraries under their charge. I am indebted to my friend Mr. J. W. Long for help with the proofs.

Genera and Species.

In the following list it has not been thought necessary to include in the synonymy references to authors who have merely repeated specific names, without description, figure, or indication of any extension of range, either of horizon, or distribution.

The dimensions of fruits etc., unless otherwise stated, are those given by the original author. For the sake of uniformity, they have all been reduced to one-thousanths of a millimetre, indicated by the sign μ.

Bechera, Sternberg, 1825.

BECHERA, Sternberg, Vers. geogn.-bot. Darst. Fl. Vorw., IV, p. XXX (1825).

An unsatisfactory genus, originated to include a number of unlike fossil plants, having articulated stems and whorled lateral members.

Bechera helicteres, Sternb. 1825.

Bechera helicteres, Sternb. l. c. p. XXXI, 1825.

Chara helicteres, Ad. Brongn. 1822, p. 321, pl. 17, fig. 3.

B. Lemani, Sternb. 1825.

Bechera Lemani, Sternb. l. c. p. XXXI, 1825.

Chara Lemani, Ad. Brongn. 1822, p. 322, pl. 17, fig. 4.

B. medicaginula, Sternb. 1825.

Bechera medicaginula, Sternb. l. c. XXXI, 1825.

Gyrogonites medicaginula, Lamarck, 1804, p. 356; 1807, pl. 17, fig. 7.

Chara medicaginula, Ad. Brongn. 1822, p. 320, pl. 17, fig. 5.

For further synonymy, remarks, and occurrence of the above, see under the several species in genus *Chara*.

CHARA, Linn.

When in the early part of last century, „Gyrogonites" were first recognized as being the fruits of Charophyta, all the living members of the group were included in the single genus, *Chara*. In 1824 Agardh divided *Chara* into two genera, *Chara* and *Nitella*. Further divisions have since been made from time to time, and the living species are now usually placed under six genera, the name *Chara* being retained for one of the larger of them.

In dealing with the fossil remains, authors, with a few exceptions have continued to use the oldest generic name, *Chara*, for all of them. From the very close resemblance of many of the fossil fruits to those of living species of *Chara*, as now understood, it is probable that such fruits are correctly referred to that genus. There are however many others, notably the original „gyrogonite", *C. medicaginula*, which al-

most certainly do not belong to *Chara*. The institution by Tuzson of a new provisional genus, *Characeites*, for those remains of Charophytes, the genera of which cannot be determined, is perhaps the most satisfactory method of dealing with them. An alternative course is to revive the generic name *Gyrogonites*, as Prof. Pia has done, but in that case the use of the name should, it is suggested, be restricted so as not to include those remains which obviously belong to *Chara*.

C. acanthica, Stache, 1880 (nomen nudum).

C. acanthica, Stache, Verh. Geol. Reichsanst. Wien, XII, p. 199, 1880, nomen nudum.

Kosmogyra acanthica, Stache, 1889, p. 135, pl. 4, fig. 5.

Vide genus *Kosmogyra*.

C. anoplotheriorum, Saporta, 1862.

C. anoplotheriorum, Saporta, Ann. Sci. Nat. Bot., ser. 4, XVII, p. 206, 1862.

C. Anaplotheriorum, Sap. Schimper, 1869, p. 231.

Gyrogonites Anoplotheriorum, Pia, 1927, p. 90.

Remarks: Regarded by the author as akin to *C. helicteres*, Brongn. Fruit described as ovate, 900 μ long, the spiral-cells showing 7—8 convolutions, with apparently a somewhat swollen apex.

Occurrence: Tertiary (Ludian?), „Marnes bitumineuses à ossements de la Debruge", Vaucluse, S. E. France.

C. aragonensis, Unger, 1850.

C. aragonensis, „Alex. Braun ms." Unger, Gen. & sp. Pl. foss., p. 35, 1850.

C. aragonensis, Al. Br. Schimper, 1869, p. 227.

Gyrogonites aragonensis, Pia, 1927, p. 90.

Remarks: Fruit described as „ovato apice subtruncato" 780—820μ long, 580—620μ broad, the spiral-cells showing 14—15 convolutions, the stem as 600—1000μ in diam. showing in transverse section 16—18 cortical cells, a larger and smaller series alternating, i. e. diplostichous, and implying whorls of 8—9 branchlets.

Occurrence: Tertiary (Ludian?), *„in stagnigene gypso- sulfuroso"* Teruel, (Aragon), Spain.

C. Archiaci, Watelet, 1866.

C. Archiaci, Watel., Descr. pl. foss. bass. Paris, p. 55, pl. 15, fig. 8, 1866.

C. Archiaci. Watel. Schimper, 1869, p. 230.

C. Archiaci, C. Prevost, Dollf. 1897, p. 605.

C. Archiaci, Watel. Dollf. & Frit., 1920, p. 251, fig. 13.

Gyrogonites Archiaci, Pia, 1927, p. 90.

Remarks: Fruit globose, diam. 1300μ; spiral-cells smooth, showing 8—9 convolutions. Apparently near *C. medicaginula*.

Occurrence: Tertiary, (Lutetian) „Calcaire lacustre moyen", Villers-Coterets and other localities in N. E. France; also recorded by MM. Dollfus & Fritel from Auversian and Marinesian beds in districts around Paris.

var. **undulata,** Dollf. & Frit. 1920.

C. Archiaci, var. *undulata*, Dollf. & Frit. Bull. Soc. Géol. France, sér. 4, XIX, p. 252, fig. 14. 1920.

Kosmogyrella undulata, Pia, 1927, p. 90.

Remarks: Differs from the type in the number of the convolutions visible (9—10), and the ridges between them being wavy.

Occurrence: Lutetian, „Calcaire grossier supérieur", Oger (Marne), N. E. France.

C. Bernoullii, Unger, 1850.

C. Bernoullii, „Alex. Braun ms." Unger, Gen. & spec. Pl. foss., p. 34, 1850.
C. Bernoullii, Alex. Br. Heer, 1855, p. 26, pl. 4, fig. 6.
C. Bernoullii, Al. Br. Schimper, 1869 p. 224.
Gyrogonites Bernoullii Pia, 1927, p. 90.

Remarks: Fruit described as „*oblongo obovato truncato*", 860μ long, 690μ broad, the spiral-cells showing 13 convolutions. From Heer's figures, the fruit would appear to be ellipsoid-biconical, the apparently truncate apex being probably due to this part being imperfectly preserved, as very frequently happens with the fossil fruits. Heer states that, according to Braun, the fruits resemble those of the author's *C. crinita* var. *pachysperma* (recent), but are somewhat larger; Schimper considers them similar to those of C. Escheri, except that they are more elliptical and the convolutions more numerous.

Occurrence: Tertiary, Miocene, Oettlingerberg, near Lorrach (Baden) Germany.

C. Blassiana, Heer, 1855.

C. Blassiana, Heer, Flor. Tert. Helv., I, p. 27, pl. 3, fig. 11, 1855.
C. Blassiana, Heer, Schimper, 1869, p. 228.
Characeites Blassianus, Pia, 1929, p. 89.

Remarks: Vegetative parts only reported, the stem corticate, described as „6-striato, striis aequalibus", while the number of branchlets is given as 7—10. This would imply a haplostichous cortex.

Occurrence: Tertiary, Miocene, „Insektenschicht des untern Bruches" Oeningen, Switzerland.

C. Bleicheri, Saporta, 1873.

C. Bleicheri, Sap., Paléont. Franc., sér. 2, Vég. Pl. Jurass., I, p. 214, Atl., pl. 9, fig. 8—11, 1873.
C. Bleicheri, Sap. Seward, 1898, p. 226, fig. 46 a.
Kosmogyra Bleicheri, Pia, 1927, p. 90.

Remarks: Fruit very small, broadly ellipsoid to nearly spherical, 390—440μ long, 350—400μ broad, the spiral-cells showing 5—6 convolutions, tuberculate, the tubercles in a single row, and at regular intervals. The figures show the fruit as tapering somewhat at each end, which hardly corresponds with the author's description.

Occurrece: Secondary, Oxfordian, Cajasc, (Lot), France.

C. (Nitella?) Boulleti, Unger, 1850.

C. (Nitella?) Boulleti, „Alex. Braun ms.", Unger, Gen. & sp. Pl. foss., p. 32, 1850.
C. Boulleti, Al. Br. Schimper, 1869, p. 221.
N. ? Boulleti, A. Braun, Pia, 1927, p. 88.

Remarks: Vegetative parts only reported. Stem and branchlets described as „simplicibus", which may be intended to indicate that they were ecorticate, and this would account for the plant being queried as belonging to *Nitella.* The only other character given is the diameter of the stem and branchlets, 250—750μ, so that the description is practically useless.

Occurrence: Tertiary, Miocene, Cornon, Clermont-Ferrand (Puy-de-Dôme), France.

C. brewsterensis, J. Groves, 1925.

C. brewsterensis, J. Groves, Amer. Journ. Sci., X, p. 12, fig. 1, 1925.
Gyrogonites brewsterensis, Pia, 1927, p. 89.

Remarks: Fruit subglobose, ca. 750μ long, 650—675μ broad, spiral-cells showing 12—13 convolutions, the apices somewhat swollen. No vegetative parts found.

Occurrence: Secondary, Cretaceous (horizon uncertain), Brewster County, (Texas), U. S. A.

C. Brongniarti, Unger, 1850.

C. Brongniarti, „Alex. Braun ms." Unger, Gen. & sp. Pl. foss., p. 35. 1850.

C. Brongniarti, Al. Br. Schimper, 1869, p. 226.

C. Brongniarti, Al. Br. Dollfus & Vasseur, 1878, p. 268.

C. Brongniarti, Al. Br. Dollfus & Fritel, 1920, p. 257, fig. 19.

Gyrogonites Brongniarti, Pia, 1927, p. 90.

Remarks: Fruit described by Unger as *„ovato-elongato v. cylindrico, valvis spiralibus a latere visis 11—12, nucleo lapideo cum spiris valde prominentibus."* Of the var. α. *oblonga* the length of the fruit is given as 950—1000 μ, of the nucleus as 800—840μ. Two of the fruits figured by MM. Dollfus and Fritel are ellipsoid-biconical, and the length given by these authors (560μ) is very much less than that of either of Unger's vars. and the number of convolutions of the spiral-cells visible (9—10) is at variance with Unger's description. MM. D. & F. indicate in the table on p. 261 that stems as well as fruits have been found but give no information as to the former.

Occurrence: (sec. D. & F.) Tertiary, Firmitien, Meulière de Beauce) Cormeilles-en-Parisis, Montmorency, Pontchartrain, Calcaire d' Étampes) Étampes, Côte Saint-Martin (Seine-et-Oise), France.

var. **cylindrella,** Unger, 1850.

C. Brongniarti, β. *cylindrella,* Unger, Gen. & sp. Pl. foss., p. 35. 1850.

Remarks: Distinguished from the type by the different dimensions of the fruit (800μ long, 480—500μ broad) and of the nucleus (680—700μ long, 400μ broad).

C. Brongniarti, Hébert, 1855 *(nomen illicitum).*

C. Brongniarti, Hebert (non Unger), Bull. Soc. Géol. France, ser. 2, XII, 2, p. 764, fig. 1.

Remarks: Described and figured by Hebert as spherical the spiral-cells showing 8 convolutions. Schimper (1869, p. 229) and Fritel (1910, p. 10) refer it to *C. sparnacensis,* Watelet, Dollfus and Fritel (1920, p. 248) to a spherical form of *C. helicteres,* Brongn.

Occurrence: Tertiary, Sparnacien, Lignites de la Champagne & du Soissonnais, France.

C. caelata, Reid &Groves, 1921.

C. caelata, Reid & Groves, Quart. Journ. Geol. Soc. LXXVII, p. 184, pl. 4, fig. 4—6, 1921.

Kosmogyra caelata, Pia, 1927, p. 90.

Remarks: Fruit spherical, diam. ca. 950μ, the spiral-cells showing about 7 convolutions, each with a single row of roundish-conical tubercles, and swollen apex. No vegetative parts identified.

Occurrence: Tertiary, Lower Headon Beds, Hordle (S. Hants), England.

var. **bicincta,** Reid & Groves, 1921.

C. caelata var. *bicincta,* Reid & Groves, l. c. p. 184, pl. 4, fig. 7—8.

Remarks: Distinguished from the type by an irregular double row of tubercles on the spiral-cells.

Occurrence: Same as the type.

var. **baccata**, Reid & Groves, 1921.
C. caelata, var. *baccata*, Reid & Groves, l. c. p. 184, pl. 4, fig. 9—10.
Remarks: Distinguished from the type by the subglobose smaller fruit, diam. ca. 850µ, the tubercles on the spiral-cells larger and less prominent, and the basal aperture broader.
Occurrence: Same as the type.

C. carinata, Stache, 1880, *(nomen nudum)*.
C. carinata, Stache, Verh. Geol. Reichsanst. Wien, 1880, no. 12, p. 198 *(nomen nudum)*.
Kosmogyrella carinata, Stache, 1889, p. 121, pl. 2, fig. 19. See under gen. *Kosmogyrella*.

C. ceratophylla, Wallr. See *C. tomentosa* (Recent).

C. cingulata, Stache, 1880,
nomen nudum.
C. cingulata, Stache, Verh. Geol. Reichsanst. Wien, 1880, no. 12, p. 198 *(nomen nudum)*.
Kosmogyra cingulata, Stache 1889, p. 121, pl. 2, fig. 20.
See under gen. *Kosmogyra*.

C. compressa, Knowlton, 1888.
C. compressa, Knowlton, Bot. Gazette, XIII, 6, p. 156, fig. 1—2 (1888).
C. compressa, Knowlton, Cockerell, 1908, p. 75.
Gyrogonites compressus, Pia, 1927, p. 90.
Remarks: Fruit described and figured as distinctly broader than long, differing in this respect from any other species except C. Oehlerti. No dimensions are given. Spiral-cells showing 10 convolutions.
Occurrence: Tertiary, Eocene, Wasatch Group, near Wales (Utah), U. S. A.

C. connivens, Braun (Recent),
? *C. connivens*, Braun, J. Groves, 1924 (2), p. 84.
Remarks: A small cylindrical fruit which bears a resemblance to this living species, which is still found in Norfolk.
Occurrence: Tertiary, Pliocene, Cromer Forest Bed, Sidestrand, (Norfolk), England.

C. contraria, Kuetz. (Recent).
C. contraria, A. Br., Nathorst, 1891, p. 20.
C. contraria, (type of), Hartz, 1902, p. 64.
C. contraria, A. Br. Brockman-Jerosch, 1910, p. 180.
C. contraria, A. Br., Bertsch, 1931, p. 84.
Remarks and Occurrence: A widely-distributely living species, but from fruits alone, especially in the fossil state, difficult to distinguish from *C. vulgaris*.

C. cosinensis, Stache, 1880 (nomen nudum).
C. cosinensis, Stache, Verh. Geol. Reichsanst. Wien, 1880, no. 12, p. 198 (nomen nudum).
Nitella (Chara) cosinensis, Stache, 1889, p. 121, pl. 3, fig. 4—6.
Gyrogonites cosinensis, Pia, 1927, p. 89.
See under gen. *Nitella*.

C. crassa, Dollfus & Fritel, 1920.
C. crassa, Dollfus& Fritel, Bull. Soc. Géol. France, sér. 4, XIX, p. 254, fig. 16 (1920).
Gyrogonites crassus, Pia, 1927, p. 90.

Remarks: Fruit described as normally subglobular, 1020—1050μ long, 1000μ broad, the spiral-cells showing 7 convolutions. Vestiges of the coronula stated to be represented by 5 thick blunt tubercles. Fragments of stems found with the fruits with a diameter of about 550μ, the cortex of 6—7 contiguous series, i. e. haplostichous.

Occurrence: Tertiary; Auversien, Sables d'Auvers & calcaire de Luzancy; Marinésien, Calcaire de Saint Ouen & Château Thierry, (Aisne), France.

C. depressa, Watelet, 1866.

C. depressa, Watel. Descr. Pl. Foss. Bass. Paris, p. 55, pl. 15, fig. 4, (1866).
C. depressa, Wat., Schimper, 1869, p. 230.
C. medicaginula, (Lam.) var. *depressa,* Dollf. & Frit. 1920, p. 259, fig. 23.
Gyrogonites depressus, Pia, 1927, p. 90.

Remarks: Fruit described as oval depressed, with apex obtuse, base more acute, 1200μ long, 1150μ broad, the spiral-cells showing convolutions, with elevated tips.
Occurrence: Tertiary; Firmitien, Étampes, (Seine-et-Oise), France.

C. de Rauwi, Leriche 1927, *nomen nudum,* see *C. Rawi.*

C. destructa, Saporta, 1863.

C. destructa, Saporta, 1861, p. 156 *(nomen nudum).*
C. destructa, Saporta, Ann. Sci. Nat. Bot. sér. 4, XIX, pp. 9 & 108. (1863).
C. destructa, Sap., Schimper, 1869, p. 231, Atl. pl. 5, fig. 18.
? *Kosmogyra destructa,* Pia, 1927, p. 90.

Remarks: Fruit described as globular, tapering very obtusely at both extremities, with a diam. of about 1 mm, spiral-cells showing 6—7 convolutions. Stem-cortex of about 5—7 series, hence may be inferred to be haplostichous.
Occurrence: Tertiary, Miocene inférieure? recorded from Vallée de Sault (Vaucluse), Barjac (Gard) & environs de Castres (Tarn), France.

C. devestita, Stache, 1889.

? *Nitella (Chara) devestita,* Stache, Abh. Geol. Reichsanst. Wien, XIII. Heft 1, p. 136, pl. 3, fig. 56 (1889).
Gyrogonites devestitus Pia, 1927, p. 89.
See under genus Nitella.

C. devonica, Wieland, 1914.

C. devonica, Wieland, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 245 (1914).

Remarks: The author's description of the organism to which he has applied this name is incomplete and there was no figure. It was evidently akin to Knowlton's *Calcisphaera Lemoni,* but smaller, the diameter being about 600μ.

Occurrence: Primary, Upper Devonian, Hamilton Shales, Snyder Creek, Calloway County, (Missouri), U. S. A.

C. distorta, Reid & Groves, 1921.

Chara distorta, Reid & Grov., Quart. Journ. Geol. Soc., LXXVII, p. 186, pl. 5, fig. 6. (1921).
Gyrogonites distortus, Pia, 1927, p. 90

Remarks: Fruit ellipsoid-fusiform, ca. 1000—1200μ long, 875—925μ broad, spiral-cells irregular, showing 7—8 convolutions, their apex little dilated, basal hollow narrow, the mouth but little dilated.
Occurrence: Tertiary, Lower Headon Beds, Hordle (Hants), England.

C. doliolum, Stache, 1880 *(nomen nudum).*
C. doliolum, Stache, 1880, p. 199, *nomen nudum.*
Cristatella (Chara) doliolum, Stache, Abh. Geol. Reichsanst. Wien, XIII, Heft 1. p. 136, pl. 4, fig. 8 (1889).
Gyrogonites doliolum, Pia, 1927, p. 89.
See under genus *Cristatella.*

C. dubia, Heer, 1855.
C. dubia, „Al. Br." Heer, Flor. Tert. Helv., I, p. 27, pl. 3, fig. 9 (1855).
C. dubia, „Al. Br.", Schimper, 1869, p. 228.
Remarks: Very imperfect vegetative remains only found, which may or may not belong to a Charophyte. No cortex is visible, but the stem was much incrusted. The whorls of branchlets (if such) were very incomplete. No description by Braun has been traced, and it is presumed that of Heer is the original. The latter author is therefore cited as the authority for the species.
Occurrence: Tertiary, Miocene (Tortonian), „in der Libellenschicht", Oeningen, Switzerland.

C. Dutemplei, Watelet, 1866.
C. Dutemplei, Watel., Descr. Pl. Foss. Bass. Paris, p. 56, pl. 15, fig. 6 (1866).
C. Dutemplei, Watel., Schimper, 1869, p. 231.
C. Dutemplei, Watel., Fritel, 1909, p. 11.
C. helicteres, Brongn. var. e. *Dutemplei,* Dollf. & Frit. 1920, p. 248, fig. 8.
Kosmogyra Dutemplei, Pia, 1927, p. 90.
Remarks: Fruit described and figured as oval, obtuse at both extremities, 1350μ long, 1150μ broad, spiral-cells showing 8 convolutions, each cell having a row of large well-marked tubercles.
Occurrence: Tertiary, Sparnacien, Lignites du mont Bernon & de Sarran, (Marne), France.

C. elegans, Dollfus & Fritel, 1920.
C. elegans, Dollf. & Frit. Bull. Soc. Géol. France, sér. 4, XIX, p. 255, fig. 17 (1920).
Gyrogonites elegans, Pia, 1927, p. 90.
Remarks: Fruit described as oval oblong, 700—750μ long, 460—500μ in diam., spiral-cells showing 7—11 convolutions.
Occurrence: Tertiary, Marinésien, Calcaire de Saint Ouen & Monsoult (Seine-et-Oise), Château Thierry (Aisne), Sannoisien, Calcaire-de-Brie & Thorigny (Seine-et-Marne), France.

var. **Morini,** Dollf. & Frit., 1920, p. 255, fig. 18.
Remarks: Fruit described as „ovale allongé, subcylindrique" (stated to resemble closely the living species C. aspera), 600μ long, about 300μ in diam., the spiral-cells showing 12—13 convolutions. Although treated in the text as a variety, in the explanation of the figure it is styled „Ch. Morini", and the description and figure suggest its being a distinct species.
Occurrence: Tertiary, Sannoisien, Calcaire de Brie, Thorigny (Seine-et-Marne), France. Some vegetative remains of a Charophyte were found in the same beds.

C. elliptica, Hislop, 1860 (nomen nudum).
C. elliptica, Hislop, Quart. Journ. Geol. Soc, XVI, p. 165 (1860).

Remarks: A name proposed to be applied to a type of fruit found in India, associated with *C. Malcolmsoni,* Sow., but of which apparently no description has been published.

C. elliptica, Fritzsche, 1924.
C. elliptica, Fritzsche, Neues Jahrb., Min. (Stuttgart) L, Beil. Bd., p. 28, pl. 2, fig. 3 (1924).

Remarks: Fruit described as „quer-ovale" in shape, but this is not apparent in the figure which shows the fruit viewed from above. The coronula is stated to have been present in one instance, but it is suggested that the much swollen tips of the spiral-cells may possibly have been mistaken for this organ. The spiral-cells showed 6 convolutions. No measurements are given, but from the scale of magnification the diameter of the fruit would appear to be about 485μ.

Occurrence: Secondary, Cretaceous, between Tres Cruces and Negri Muerta (Prov. Jujuy), N. Argentina, S. America.

C. Escheri, Unger, 1850.
C. Escheri, „Alex. Braun ms.", Unger, Gen. & sp. Pl. foss., p. 34 (1850).
C. Escheri, Al. Br. Gaudin, 1854, p. 28.
C. Escheri, Al. Br. Heer, 1855, p. 25, pl. 4, fig. 5.
C. Escheri, Al. Br. Unger, 1860, p. 48, p. 4, fig. 1—5.
C. Escheri, Al. Br. Capell., 1861, pp. 374, 384.
C. Escheri, Al. Br. Heer, 1862, p. 375.
C. Escheri, Al. Br. Schimper, 1869, p. 223, Atl. pl. 5, fig. 43—45.
?C. Escheri, Al. Br. Peruzzi, 1876, p. 63.
C. Escheri, Al. Br. Zsigm., 1878, p. 727.
C. Escheri, Heer, Schenk, 1879, p. 43, fig. 35 (7).
C. Escheri, Al. Br. Heer, 1883, p. 325.
C. Escheri, Al. Br. Mesch & Squin., 1893, p. 83.
C. Escheri, Al. Br. Lorenth., 1895, p. 115.
Gyrogonites Escheri, Pia, 1927, p. 90.

Remarks: The fruit is described by Unger as being oblong-obovate truncate above, 700—800μ long, 550—620μ broad, the spiral-cells showing 9—10 convolutions.

Occurrence: Originally described from Tertiary (Miocene), at Oetlingberg, near Lorrach (Baden), and Schwamendingen, near Zurich (Switzerland); subsequently recorded by Gaudin from Lignites de Paudex (Switzerland); by Heer from other localities in Switzerland and Baden, also from Hamstead Beds, Isle of Wight (England); by Schimper from Schoenstein (Styria); by Capellini from „ligniti della bassa Val di Magra", Liguria (Italy); by Peruzzi (with some doubt) from Casino near Siena (Italy); by Zsigmondy from Stadtwäldchen, Budapest (Hungary).

C. estanciana, Hannibal, 1918.
C. estanciana, Hannibal, Science (New York), XLVIII, p. 578 (1918).

Remarks: The only description furnished by the author is that the fruits „resemble the nutlets of the Bear River stone-wort, Chara Stantoni Knowlton, but are nearly round and marked by six encircling spirals".

Occurrence: Secondary, „Jura-Cretaceous", from a block of white chert of uncertain origin „supposedly from Arkansas", U. S. A.

C. flexilis, L. See *Nitella flexilis,* Agardh.

C. foetida, Braun. See *Chara vulgaris,* L.

C. fragilis, Desvaux (Recent).
C. fragilis, Holst, 1906, p. 62.
C. fragilis, Holst, 1908, p. 17.
C. fragilis, Desv. Stoller, 1909 (1) p. 74, (2) p. 109.
C. fragilis, Desv., Bertsch, 1931, p. 84.

Remarks: The most widely distributed of all living species, and remains may therefore be expected to occur in many of the more recent deposits.

Occurrence: All the records refer to quite late deposits.

C. fyeensis, Crié, 1877.
C. fyeensis, Crié, Ann. Sci. Géol., IX, p. 21, pl. A, fig. 1 (1877).
C. fyeensis, Crié, Couffon, 1909, p. 15.
?Characeites fyeensis, Pia, 1927, p. 89.

Remarks: The author's description and figure refer to some fragments of an irregularly branched stem which may possibly belong to a Charophyte.

Occurrence: Tertiary, Eocene of Saint Saturnin, Fyé (Sarthe), France; Bartonien supérieur (Marinésien), Anjou, France (fide Couffon).

C. Gardnerae, Groves, 1925.
C. Gardnerae, Groves, Amer. Journ. Sci., X, p. 14, fig. 3 (1925).
Gyrogonites Gardnerae, Pia, 1927, p. 89.

Remarks: Oogonium ellipsoid, tapering slightly at both ends, ca. 700—900μ long, 500—675μ broad, spiral-cells showing about 13 convolutions.

Occurrence: Tertiary, Basal Eocene (Midway formation), Bastrop County, (Texas), U. S. A.

C. Gebhardi, Ottmer, 1880 (nomen nudum).
C. Gebhardi, Ottmer, Jahrb. Ver. Naturw. Braunschw. for 1879—1880, p. 71 (1880).

Remarks: Charophyte fruit referred to at a meeting, to be described subsequently.

Occurrence: Secondary, Kimmeridgian, Langenberg near Oker (Brunswick), Germany.

C. globulus, Stache, 1889.
? *Nitella (Chara) globulus,* Stache, Abh. Geol. Reichsanst. Wien, XIII, Heft 1, p. 121, pl. 1 a, fig. 16 (1889).
Gyrogonites globulus, Pia, 1927, p. 89.
See under genus *Nitella.*

C. glomerata, Lesquereux, 1883 *(nomen illicitum).*
? *C. glomerata,* Lesq. (non Desvaux, 1810), Rep. U. S. Geol. & Geogr. Surv. Terr., VIII, p. 135, pl. 21, fig. 12 (1883).

Remarks: From the description and figure it seems very improbable that the remains belong to a Charophyte.

Occurrence: Tertiary, Green River Group, Florissant, (Colorado), U. S. A.

C. granulifera, Heer, 1855.
C. granulifera, Heer, Fl. Tert. Helv., I, p. 27, pl. 4, fig. 8 (1855).
C. granulifera, Heer, Gaudin, 1854, p. 28.
C. granulifera, Heer, Schimper, 1869, p. 228, Atl. pl. 5, fig. 47.
C. granulifera, Heer, Mieg, Bleich. & Fliche, 1890, pp. 409, 413.
Gyrogonites granulifer, Pia, 1927, p. 90.

Remarks: Fruit described and figured as globose, having a diam. of about 500μ, the spiral-cells showing 7—8 convolutions.

Occurrence: Tertiary, recorded by Heer from „grauen Mergel" Paude and Belmont (Vaud), Switzerland, by Mieg, Bleich. & Fliche from Coupe de Rixheim, chemin de Zimmersheim (Alsace) in „Calcaire greseux, sableux avec Melania".

C. Grepini, Heer, 1859.

C. Grepini, Heer, Fl. Tert. Helv., III, p. 150, pl. 141, fig. 108—109 (1859).
C. Grepini, Heer, Schenk, 1879, p. 43, fig. 35 (5).
C. Grepini, Heer, 1883, pp. 275, 287, fig. 186.
C. Grepini, Heer, Schimper, 1869, p. 228, Atl. pl. 5, fig. 48—49.
Kosmogyra Grepini, Pia, 1927, p. 90.

Remarks: Fruit described and figured as subglobose, ca. 1000μ long, 800μ broad, spiral-cells showing 8—9 convolutions, each bearing a row of tubercles. Evidently very close to, if not identical with, *C. tuberculata,* Lyell.

Occurrence: Tertiary, Eocene, „terrain sidérolitique", Develiern near Délémont, Switzerland.

C. guttifera Stache, 1880 *(nomen nudum).*

C. guttifera, Stache, Verh. Geol. Reichsanst. Wien, 1880, no. 12, p. 199 (nomen nudum).
Kosmogyra (Chara) guttifera, Stache, 1889, p. 134, pl. 4, fig. 6. See under genus *Kosmogyra.*

C. gypsorum, Saporta, 1862.

C. gypsorum, Sap. 1861, p. 143. *(nomen nudum).*
C. gypsorum, Sap. Ann. Sci. Nat. Bot., sér. 4, XVII, p 207 (1862).
C. gypsorum, Sap. Schimper, 1869, p. 231.
C. gypsorum, Sap. 1873 (1), p. 6, pl. 1, fig. 1—2.

Remarks: Vegetative parts only found. Described by author (1862) as „Fragments des tiges verticillées par trois-six.", and subsequently 1873 (1) as „Fragments de tige, épars, gréles, rugueux, formés de 7 tubes accolés autour du tube central et parsémes extérieurement de rugosités fines." From this description it would appear that the cortex was haplostichous.

Occurrence: Tertiary, Oligocene, Stampian, „Gypses d'Aix, partie supérieure", and „environs d'Eguilles", S. E. France.

C. helicteres, Ad. Brongniart, 1822.

C. helicteres, Ad. Brongn., Mém. Mus. Nat. Hist. Paris, VIII, p. 321, pl. 17, fig. 3 (1822).
C. helicteres, Cuvier & Al. Brongn. 1822 (1), p. 368, pl. 11; fig. 8.
Bechera helicteres (Brongn.), Sternb. 1825, p. 31.
C. helicteres, Brongn., Unger, 1845, p. 17.
C. helicteres, Brongn., Graves, 1847, p. 707.
C. helicteres, Brongn., Unger, 1850, p. 33.
C. helicteres, Brongn., Forbes, 1853, p. 266.
C. helicteres, Brongn., Salter, 1856, p. 159 pl. 7, fig. 3—5.
C. helicteres, Brongn., Heer, 1859, p. 149.
C. helicteres, Ad. Brongn., Watel. 1866, p. 52, pl. 15, fig. 5.
C. helicteres, Brongn. Schimper, 1869, p. 222, Atl. pl. 5, fig. 20—32.
C. helicteres, Brongn. Schenk, 1879, p. 43, fig. 35 (4).
C. helicteres, Brongn., Heer, 1883, p. 287.
C. helicteres, Ad. Brongn. Fritel, 1909, p. 10.
C. helicteres, Ad. Brongn. Dollf. 1912, p. 824.
C. helicteres, Al. Brongn. Dollf. & Fritel, 1920, p. 245, fig. 1—4.
C. helicteres, Brongn., Reid. & Grov. 1921, p. 186, pl. 5, fig. 11.

C. helicteres, Brongn., Groves, 1924 (2), p. 84, pl. 45, fig. 18.
C. helicteres, Brongn., Groves, 1926, p. 169, pl. 12, fig. 6.
Gyrogonites helicteres, Pia, 1927, p. 90.

Remarks: The fossil fruits described under this name by various authors appear to be dissimilar, and probably do not belong to a single species. Ad. Brongniart described the fruit of the original plant as ovoid, giving no measurements, and described and indicated the spiral-cells as showing 8 convolutions, the tips salient and somewhat tumid, and a little below, „un leger etranglement". He did not refer to any vegetative parts having been found. Unger (1850) describes the fruit as subglobose, 1250—1350μ long, 1180—1250μ thick, the spiral-cells showing 11 convolutions, and adds a reference to the stem as „tubulis 9—12 corticato". Schimper's description (1869) is almost identical with Unger's. Watelet (1866) has an excellent figure in which the spiral-cells show 8 convolutions, Salter shows the same number in the English fruits. MM. Dollfus and Fritel (1920) describe the spiral-cells of what they regard as the type showing 8—9 convolutions, but figure them as showing 11. Reid & Groves give 8—9 for the Hampshire fruits.

MM. Dollfus and Fritel include under *C. helicteres:* a. *C. helicteres sens. strict.;* b. *C. sparnacensis,* Watel.; c. *C. Brongniarti,* Hébert (non Unger), a perfectly spherical type; and d. and e. *C. onerata,* Watel. and *C. Dutemplei,* Watel., both tuberculate types.

Occurrence: Eocene and Oligocene. France: Terrain d'eau douce supérieur à Pleurs (Aisne). Ad. Brongn. 1822. Lel dépots d'eau douce inférieur, près d'Épernay (Marne), Schimper, 1869; Thanetien, Marnes de Chenay (Marne); Calcaire de Mortemar et de Pronleroy (Oise); Sparnacien, Marnes des lignites dites „cordons blancs" à Antheuil, Canly, Cuvilly, Ognolles, Saint Sauveur, Mont Soufflars (Oise); Mont Bernon, Grauves, Sarran (Marne), Dollfus & Fritel, 1920. Switzerland: Terrain sidérolitique, „in der groupe fluvio-terrestre inférieur à la Croisic, bei Délémont" (Heer). England: Hamstead Beds, (Isle of Wight) Forbes, 1853; Lower Headon Beds, Hordle (Hampshire), Reid & Groves, 1921.

C. hispida, Linn. (an existing species).
C. hispida Schlotheim, 1832, p. 3.
C. hispida, Solms-Laubach, 1887, p. 38.
C. hispida, Wallr. or *C. intermedia,* A. Br. Andersson, 1889, p. 36.
C. hispida, Al. Br., Rolland, 1890, pp. 56 & 122.
C. typ. *hispida,* Hartz, 1902, p. 64.
cf. *C. hispida,* L. Brockman-Jerosch, 1910, p. 180.

Remarks: A common European species, which might be expected to occur in very recent deposits. The fruits are very similar to, but much larger than, those of the allied species, *C. vulgaris,* L.

Occurrence: It was obtained by Solms-Laubach from Cannstadt and Weimar, Germany; by Andersson from „Quartar-formation", Skåne, Sweden; by Rolland from „Calcaire marneux concrétionné". Tamerda-Djedida, Sahara; by Hartz from „Senglacial", Denmark.

var. **fossilis,** Lyell, 1826.
C. hispida var. *fossilis,* Lyell, Trans. Geol. Soc., ser. 2, II, p. 73, pl. 12, fig. 1. (1826).
C. hispida var. *fossilis,* Lyell, Ad. Brongn. 1828, p. 71.
C. hispida var. *fossilis,* Lyell, Unger, 1845, p. 17.
C. hispida var. *fossilis,* Lyell, Unger, 1850, p. 35.
C. hispida var. *fossilis,* Lyell, Schimper, 1869, p. 232.
C. hispida var. *fossilis,* Lyell, Hartm. 1907, p. 16.

Remarks: Lyell (l. c.) figures the oospore as well as the oogonium. The cortex of the fragment of stem, as shown in fig. 1, does not correspond with that of *C. hispida,* being apparently haplostichous, the

series of equal diameter, whereas, as Lyell himself shows in fig. 2, which represents the living plant, of *C. hispida*, the cortex in that species as diplostichous, the secondary series being thicker than the primary.

Occurrence: Lyell's original specimens were from a quaternary deposit on the shores of L. Bakie, Forfarshire, Scotland; Schimper recorded it from calcaire quaternaire (travertin), Cannstatt, near Stuttgart, Germany; Hartmann from diluvial deposits at Ingramsdorf, Silesia.

var. **brachyphylla,** Fliche, 1883.

C. hispida, L. var. *brachyphylla,* Fliche, 1883, Bull. Soc. Géol. France, sér. 3, XII, p. 15.

Occurrence: „Tufs quaternaires de Resson,

C. inconspicua, Unger, 1850.

C. inconspicua, „Alex, Braun m. s.", Unger, Gen. & sp. Pl. foss., p. 34 (1850).
C. inconspicua, Heer, Gaudin, 1854, p. 28.
C. inconspicua, „Al. Br.", Heer, 1855, p. 26, pl. 4; fig. 7.
C. inconspicua, „Al. Br.", Schimper, 1869, p. 225.
C. inconspicua, Heer, Schenk 1879, p. 43, fig. 35 (6).
C. inconspicua, „Al. Br.", Engel, 1908, p. 567.
Gyrogonites inconspicuus, Pia, 1927, p. 90.

Remarks: Fruits small, broadly ellipsoid, but little tapering at the ends, 460—540 μ long, 400—460 μ broad, the spiral-cells showing 10 convolutions.

Occurrence: Tertiary, Marnes de Paudex, Oettlingerberg and Tullingerberg (Baden), Obermiocän, Ries (Württemberg), Germany; Paudex & Rochette (Vaud), Schwammendingen (Zürich), Switzerland.

C. intermedia, Braun, 1867 (Recent).

C. intermedia, Braun, 1867, *(C. papillosa,* Kuetz. 1834).
C. hispida, Wallr., or *C. intermedia,* A. Br. Andersson, 1889, p. 36.
Occurrence: „Quatar-formation", Skåne, Sweden.

C. Jaccardi, Heer, 1865.

C. Jaccardi, Heer, Die Urwelt der Schweiz, p. 218, fig. 134, 1865.
C. Jaccardi, Heer, Loriol & Jaccard, 1865, p. 108, pl. 3, fig. 21—24.
C. Jaccardi, Heer, Schimper, 1869, p. 231.
C. Jaccardi, Heer, Schenk, 1871, p. 204, pl. 25, fig. 1.
C. Jaccardi, Heer, Saporta, 1873 (2), p. 216, pl. 9, fig. 12—13.
C. Jaccardi, Heer, 1877, p. 124, pl. 43, fig. 23—24.
C. Jaccardi, Heer, 1883, p. 176, fig. 130.
C. Jaccardi, Heer, Maillard, 1884, p. 17.
C. Jaccardi, Heer, Girardot, 1885, pp. 767—8.
C. Jaccardi, Heer („probablement"), Joukowsky & Favre, 1913, p. 314, pl. 13, fig. 3—6.
C. Jaccardi, Heer („probablement"), Stastny, 1930, p. 55, pl. 7; fig. 1—3.
Gyrogonites Jaccardi, Pia, 1927, p. 89.

Remarks: The remains, with the exception of those referred with some doubt to this species, consist of detached fruits. The fruit is ellipsoid, the dimensions given by Heer as 720 μ long, 550 μ broad, by Schimper as 600 μ long, 400 μ broad, the spiral-cells showing 6 convolutions.

Occurrence: Secondary, „(Wealdien) entre le Portlandien et le Valangien". (Schimper), near Locle, Cant. Neufchatel (Heer); Villers-le-Lac & Jorat, Cant. Vaud (Lor. & Jacc.) Switzerland, Purbeckian, near Baulmes, Cant. Vaud (Maillard); Pont de la Chaux (Girardot);

Purbeckian; Ridgway Hill, Dorset, England (fide Lor. & Jacc.). The remains considered to belong probably to C. Jaccardi by MM. Joukowsky & Favre, were from Étournelles and Aiguebelle, Purbeckian, Savoie; those collected by M. Stastny from near Grenoble, Dept. Isère, France.

C. Knowltoni, Seward, 1894.

C. Knowltoni, Seward, Cat. Mesoz. Pl. Brit. Mus. Weald. Fl., I, p. 13, fig. 1. 1894.

C. Knowltoni, Seward, 1898, p. 226, fig. 47.

Gyrogonites ? *Knowltoni,* Pia, 1927, p. 89.

Remarks: Described as broadly oval, about 500 μ in length, and about the same breadth in its broadest part, the spiral-cells figured as showing 11 convolutions. The late Clement Reid made a careful examination of the type specimens in the British Museum and arrived at the conclusion that they do not represent remains of any Charophyte, in which view I concur. The vegetative parts ascribed also to C. Knowltoni from the Purbeck Beds of Dorset, and shown in fig. 2 (1894) and fig. 45 ab (1898), probably belong to *Clavator Reidii.*

Occurrence: Secondary, Wealden, near Hastings, Sussex, England.]

C. laevigata, Upton, 1909.

C. laevigata, Upton, Proc. Cotteswold Nat. Field Club, XVI, p. 238, pl 27, fig. 2, 1909.

Gyrogonites laevigatus, Pia, 1927, p. 89.

Remarks: Fruit ellipsoid-biconical variable in size, about three quarters as broad as long, the length being given by the author as → 025 in. (= c. 640μ), spiral-cells showing about 11 convolutions. [Specimens measured by the present writer exhibited a considerable range in length, from c. 575 μ to c. 800 μ, and showed a marked projection at the base.]

Occurrence: Secondary, Inferior Oolite (Forest Marble), in company with Ostracoda and Foraminitera, Tarlton, Gloucestershire, England.

C. Langeri, Ettingshausen, 1872.

C. Langeri, Ettingsh. Denks. Akad. Wiss. Wien, XXXII, p. 162, pl. 1, fig. 2—4 (1872).

Gyrogonites Langeri, Pia, 1927, p. 90.

Remarks: Stem described as 900—1000 μ thick, „10-striato", and the number of branchlets as 6, from which it may perhaps be inferred that the cortex was diplostichous, and the number of cortical series really 12; fruit described as „ovali-globoso" 1000 μ long, 900 μ broad, spiral-cells showing 8—9 convolutions *„transversim rugosis cristam prominentem efficientibus".*

Occurrence: Tertiary, Oligocene, Sagor, and Savine (Krain), Yugoslavia.

C. latiuscula, Saporta, 1861.

C. latiuscula, Saporta, Exam. fl. tert. Prov., in Heer, Rech. clim. et vég. pays Tert. p. 160, 1861.

Remarks: Vegetative parts only found.; described as „assez larges, finement striées et fasciculées par 3 ou 4".

Occurrence: Tertiary, Miocene, Manosque (Provence), France.

C. Lemani, Ad. Brongniart, 1822.

C. Lemani, Ad. Brongn. Mém. Mus. Hist. Nat. Paris, VIII, p. 322, pl. 17, fig. 4 (1822).

C. Lemani, Cuvier & Al. Brongn. 1822 (1), p. 369, pl. 11, fig. 9.

Bechera Lemani, Sternb .1825, p. 31.
C. Lemani, Brongn., Unger, 1845, p. 17.
C. Lemani, Brongn., Graves, 1847, p. 708.
C. Lemani, Brongn., Unger, 1850, p. 33.
C. Lemani, Brongn., Watelet, 1866, p. 53, pl. 15, fig. 7.
C. Lemani, Brongn., Schimper, 1869, p. 222.
C. Lemani, Brongn., Fritel, 1909 (2), p. 323.
C. Lemani, Brongn., Dollf. & Frit. 1920, p. 253, fig. 15.
Gyrogonites Lemanii, Pia, 1927, p. 90.

Remarks: Fruit described by Brongniart as „ovale, presque cylindroide" the spiral-cells showing 6 convolutions. Unger (1850) adds „infra truncato" and gives the dimensions as 1050 μ long, 900 μ broad. The truncation of the base, as figured, may be due to the fruit being imperfect. Most authors reproduce Brongniart's original figure. No vegetative remains aore reported Tertiary.

Occurrence: Recorded by Brongniart from „les silex cornes du terrain d'eau douce inférieur à St. Ouen". Dollfus & Fritel record it from: (Lutétien supérieur) Ferme de l'Orme (Seine-et-Oise), Passy (Seine); Marinésien, Calcaire de Saint Ouen, Acy en Multien (Oise), Saint Ouen (Seine) France and from Auversien (without locality).

C. liassica, Moore, 1867 (nomen nudum).

C. liassica, Moore, Quart. Journ. Geol. Soc., XXIII, p. 538 (1867) *nomen nudum*.
C. liassica, Moore, Seward, 1904, p. 27.
Gyrogonites ? *liassicus*, Pia, 1927, p. 89.

Remarks: Based on a single fruit, of which there is neither description nor figure, found associated with Liassic remains. The specimen cannot be traced, and, in the absence of further evidence, its ascription to the Lias formation is open to doubt.

Occurrence: Horizon doubtful, Charterhouse mine, (Somerset), England.

C. Lyelli, Unger, 1850.

C. medicaginula, Lyell (pro parte) 1826, Trans. Geol. Soc. ser. 2, II, p. 93, pl. 13, fig. 5.
C. Lyelli, „Alex Braun, ms." Unger, Gen. & sp. Pl. foss., p. 33 (1850).
C. Lyellii, Forbes, 1853, p. 267.
C. Lyellii, „Forbes ms." Salter, 1856, pp. 159—160, pl. 7, fig. 7—10.
C. Lyelli, Al. Br., Schimper, 1869, p. 222.
C. Lyelli, „Forbes" Van den Broeck, 1881, p. 130.
Gyrogonites Lyellii, Pia, 1927, p. 90.

Remarks: Fruit described by Unger as „*oblongo utrinque parumper acuminato, valvis spiralibus a latere visis 10*", presumably based on the fruit figured by Lyell, pl. 13, fig. 5, which Lyell himself considered to be distorted. No vegetative remains were reported from the original locality, but these are stated to be present with the fruit in the Belgian station.

Occurrence: Tertiary, Oligocene, Bembridge Beds, Whitecliff Bay; Osborne Beds, St. Helen's etc. (Isle of Wight), England: Tongrien, „Étage supérieur ou fluvio-marin", Limburg, Belgium. (Van den Broeck).

C. Maillardi, Saporta, 1891.

C. Maillardi, Saporta, Pl. Jurass., Paleontol. Franc., sér. 2, IV, p. 498, Atl. pl. 72 bis, fig. 6a, 7ab (1891).

Remarks: The „fruits" described and figured are quite unlike the oogonia of any Charophyte, being ± pyriform bodies with numerous irregular longitudinal ridges, measuring c. 600—800 μ in length.

They may possibly be analogous to the utricles enclosing the oogonia of *Clavator Reidii*, J. Groves.

Occurrence: Secondary. „Couches lacustres du Purbeckian superieur et niveau saumatre immediatement superposé à ces couches", Pont de la Chaux, près de Chatelneuf (Jura).

C. Malcolmsonii, Sowerby, 1840.

C. Malcolmsonii, Sowerby, Trans. Geol. Soc., ser. 2, V, pl. 47, fig. 1 (1840).
C. Malcolmsonii, Hislop, 1860, p. 165.
Gyrogonites Malcolmsonii, Pia, 1927, p. 89.

Remarks: Fruit described as oblong-spheroidal, the spiral-cells showing 10 convolutions. From one of the figures the tips of the spiral-cells appear to be somewhat swolleni.

Occurrence: Secondary, Upper Cretaceous, Sichel Hills, Central India.

C. medicaginula, Ad Brongniart, 1822.

Gyrogonites medicaginula, Lamarck, 1804, Ann. Mus. Nat. Hist. (Paris), V, p. 356, IX (1807), pl. 17, fig. 7abc.
Gyrogonites medicaginula, Lam. Montfort, 1808, p. 182, pl. 46.
„*Gyrogonite medicaginule*", Brard, 1809, p. 438, fig. 27—29.
Gyrogonites medicaginula, Lam., Al. Brongn., 1810, p. 381, pl. 23, fig. 12.
Chara medicaginula, Ad. Brongn.Mem. Mus. Nat. Hist. (Paris), VIII, p. 320, pl. 17, fig. 5 (1822).
C. medicaginula, Cuvier & Al. Brongn., 1822 (1), p. 369, pl. 11, fig. 7.
Bechera medicaginula, Sternb., 1825, p. 31.
C. medicaginula, Brongn., Lyell, 1826, p. 93, pl. 13, fig. 1—6.
C. medicaginula, Brongn., Unger, 1845, p. 16.
C. medicaginula, Brongn., Graves, 1847, p. 707.
C. medicaginula, Brongn., Unger, 1850, p. 32.
C. medicaginula, Brongn., Forbes, 1853, p. 266.
Gyrogona medicaginula, Lam. Costa, 1855, p. 135.
C. medicaginula, Brongn., Salter, 1856, pp. 159—161, pl. 7, fig. 1—2.
C. medicaginula, Brongn., Watelet, 1866, p. 52, pl. 15, fig. 3.
C. medicaginula, Brongn., Schimper, 1869, p. 221, Atl. pl. 5, fig. 38—42.
C. medicaginula, Brongn., Schenk, 1879, p. 43, fig. 35 (1—3).
C. medicaginula, Crie, 1886, p. 563.
C. medicaginula, Harris & Burrows, 1891, p. 63.
? *C. medicaginula*, Brongn., Mieg, Bleich. & Fliche, 1892, p. 186.
C. medicaginula, Brongn., Dollfus & Fritel, 1920, p. 257, fig. 20.
C. medicaginula, Brongn., Groves, 1926, p. 167, text fig. 16, pl. 12, fig. 4.
Gyrogonites medicaginula, Pia, 1927, pp. 89—90, fig. 73.

Remarks: The fruit of this species, the original „Gyrogonite", was placed by Lamarck among the fossil Mollusca, but with some doubt, for he writes „est elle réallement une coquille muttiloculaire?". In 1812 Leman identified it as the fruit of a Charophyte. The fruit is very large, more than 1 mm. in diameter, and is spherical. The spiral-cells show about 8 convolutions and are much swollen at their tips, the cells being somewhat constricted just below. This has led to the impression that the swollen tips are the remains of a coronula. The spherical form of the fruit is remarkable, there being no existing Charophyte with a fruit of this shape. The nearest approach to it among living types is that of Tolypella nidifica, Leonh. which has the oogonia nearly spherical, but not more than half the diameter of that of C.

medicaginula. No member of the Division Chareae, has fruit so nearly spherical, the nearest, Nitellopsis (= Tolypellopsis, Mig.) has an ellipsoid oospore, whereas that of C. medicaginula, like those of Tolypella correspond in shape with the oogonium. The tips of the spiral-cells are swollen in some living species of Nitella and Tolypella, and are associated with a deciduous coronula.

Vegetative remains have been associated with the fruits of this species, the stem having, according to Unger, a cortex of about 20 series and the branchlets, also corticate, numbering 8—10.

In all probability this and the other spherical types belong to an extinct species, possibly connecting the Chareae and the Nitelleae. None of the living species of the latter division has a corticate stem.

Occurrence: Tertiary. Originally obtained from beds in the Paris basin. Its distribution in this region is summarised by Dollfus and Fritel as follows: „Firmitien: Très commune dans toutes les localités ou l'on peut observer les calcaires de Beauce et le niveau inférieur des meulières dites ‚de Montmorency'" Crié (1886) records it from the Miocene of Brittany, Lyell 1826 from Bembridge Beds (Oligocene), Isle of Wight, England; Forbes, (1853) and Salter (1856) from Hamstead Beds, (Oligocene), Isle of Wight. The fruits referred to by MM. Mieg, Bleicher & Fliche (1892) were from Oligocene, Klein Kembs (Alsace), France. Fruits collected from a Wealden deposit, Fairlight Glen, Hastings (Sussex), England, and from London Clay (Ypresian), Islington, London, are considered by the present writer to be referable to this species.

var. **minor,** Unger, 1850.

var. *minor,* Unger, Gen. & sp. Pl. foss. p. 32, 1850.

var. *minor,* Dollf. & Fritel, 1920, p. 258, fig. 21.

var. *minor,* Dollf. & Fritel, Heim, 1923, p. 476, fig. 7.

Remarks: Apparently only distinguished from the type by its smaller size,

Occurrence: Firmitien, Calcaire de Beauce (marnes d'Étampes), Étampes, côte Saint Martin (Seine-et-Oise), France. Oligocene, Dept. Gard, France (Heim).

var. **polygyrata,** Dollf. & Fritel, 1920.

var. *polygyrata,* Dollf. & Fritel, l. c. p. 259, fig. 22.

Remarks: Of the same size as the type, distinguished by the presence of a ridge along the middle of the spiral-cells. Identified by the authors with Lyell's figures 2 & 3, pl. 13 of the 1826 paper.

Occurrence: Firmitien, Calcaire de Beauce, Étampes, and Meulière de Beauce, Montmorency (Seine-et-Oise), France.

var. **depressa,** Dollfuss & Fritel, 1920.

var. *depressa,* Dollf. & Fritel, l. c., p. 259, fig. 23.

Remarks: Based entirely upon C. depressa, Watelet, which however the authors regard as merely a „deformation" of the type.

Occurrence: Firmitien, Calcaire de Beauce, Étampes, Côte Saint Martin (Seine-et-Oise) France.

C. Meriani, Unger, 1850.

C. Meriani, „Alex. Braun ms." Unger, Gen. & sp. Pl. foss., p. 34 (1850).

C. Meriani, Al. Br., Heer, 1855, p. 24, pl. 4, fig. 3.

C. Meriani, Al. Br., Unger, 1852, p. 82, pl. 25, fig. 10—12.

C. Meriani, Al. Br., Gaudin, 1854, p. 28.

C. Meriani, Al. Br., Schimper, 1869, p. 223, Atl. (1874) pl. 5, fig. 50—54.

C. Meriani, Al. Br., Ettingsh. 1872, p. 161.

C. Meriani, Al. Br., Heer, 1883, p. 325.

C. Meriani, Al. Br., Probst, 1884, p. 83.
C. Meriani, Al. Br., Squinabol, 1889 (1), p. 75.
C. Meriani, Al. Br., Squinabol, 1889 (2), p. 7, pl. 12, fig. 1—2.
C. Meriani, Al. Br., Mesch. & Squin. 1893, p. 84.
? *C. Meriani*, Hartm., 1907, pp. 11 & 16.
C. Meriani, Al. Br., Engel, 1908, pp. 561, 564.
? *C. Merianii*, Braun, Groves, 1920, p. 127, fig. 1.
C. Meriani, Al. Br., Principi, 1921, p. 7.
Gyrogonites Meriani, Pia, 1927, p. 90.

Remarks: Fruit described by Unger as oblong-obovate, 1050—1250μ long, 900—1100μ broad, the spiral-cells showing 9—10 convolutions. The author's figures in Iconographia (1852) are unsatisfactory, but Heer (1855) gives a series of excellent illustrations. In one of these (3n), the spiral-cells are shown as much swollen at the tips. The upper half of the fruit is distinctly the broader, which character seems to distinguish it from the other large types from Tertiary formations. The specimen figured by Unger, 1852, pl. 25, fig. 10 was renamed *C. Ungeri* by Ettingshausen.

Occurrence: Tertiary, Miocene. Recorded from Germany, Oettlingerberg (Baden), Heggbach, Adelegg and Isny (Württemberg); many localities in various parts of Switzerland; Italy, S. Giustina (Liguria), from Miocene and Oligocene, fide Principi (1921). Oligocene, Sagor, Savine (Krain) Yugoslavia.

C. minima, Saporta, 1868.
C. minima, Sap., Mém. Soc. Géol. France, sér. 2, VIII, 3, p. 308, pl. 22, fig. 3 (1868).
C. minima, Sap., Fritel, 1903, p. 118, fig. 104.
C. minima, Sap., Dollf. & Fritel, 1920, p. 245.
Characeites minimus, Pia, 1927, p. 89.

Remarks: Vegetative parts only reported, the stem corticate, cortical series about 12—15, branchlets 10—12, in a whorl. The description and figure are too vague for identification.

Occurrence: Tertiary, Thanétien, Travertin de Sézanne (Marne), France.

C. Morini, Dollf. & Frit. See *C. elegans* var. *Morini*, D. & F.

C. neogenica, Engelhardt, 1880.
C. neogenica, Engelh. Sitz. Nat. Ges. Isis, Dresden, 1880, p. 135, pl. 7, fig. 3—5.

Remarks: Vegetative parts only reported, consisting of a stem and imperfectly whorled branches. These may possibly belong to a Charophyte, but are unidentifiable.

Occurrence: Tertiary, Miocene, Cyprischiefer, Northern Bohemia.

C. nielfalensis, Dollfus & Fritel, 1920.
C. Nielfalensis Dollf. & Fritel, Bull. Soc. Géol. France, sér. 4, XIX, p. 250, fig. 12 (1920).
Kosmogyra Nielfalensis, Pia, 1927, p. 90.

Remarks: Fruit described as ovoid, 800—850μ long, 700—750μ broad, the spiral-cells showing 9—10 convolutions, furnished with fairly evenly-spaced tubercles.

Occurrence: Tertiary, Sparnacien, Argiles ligniteuses, Neaufles-Saint Martin (Eure), France.

C. Oehlerti, Dollfus, 1921.
C. Oehlerti, Dollf. Bull. Soc. Géol. Min. Bret., II, 1, p. 88, pl. 1, fig. 9 (1921).

Remarks: Fruit described as subglobose flattened 900—1000μ in height, 1200—1300μ, in diam, the spiral-cells showing only 5 convolutions, the tips apparently swollen.

Occurrence: Tertiary, Marnes Oligocènes de Thévalles, près Laval, (Mayenne) France.

C. onerata, Watelet, 1866.

C. onerata, Watel. Descr. Pl. Foss. Bass. Paris, p. 56, pl. 15, fig. 2 (1866).
C. onerata, Watel. Schimper, 1869, p. 230.
C. onerata, Watel. Fritel, 1909, p. 11.
C. helicteres, Brongn., var. d. *onerata,* Dollf. & Fritel, 1920, p. 248, fig. 7.
Kosmogyra onerata, Pia, 1927, p. 90.

Remarks: Fruit described and figured as globose, 1400μ in diam., the spiral-cells showing 7—8 convolutions, each furnished with a well-marked single row of evenly-spaced tubercles.

Occurrence: Tertiary, Sparnacien, Marnes des lignites de Pont Ste. Maxence (Oise), France.

C. ornata, Stache, 1880 *(nomen nudum).*

C. ornata, Stache, Verh. Geol. Reichsanst. Wien, 1880, no. 12, p. 199 (nomen nudum).
Kosmogyra ornata, Stache 1889, p. 134, pl. 4, fig. 4.
See under genus *Kosmogyra.*

C. ovalis, Fritzsche, 1924.

C. (Nitella ?) ovalis, Fritzsche, Neues Jahrb. min. (Stuttgart) Beil.-Bd. p. 28, pl. 2, fig. 2 (1924).

Remarks: Fruit described as „längs-oval", and as being similar to that of C. Jaccardi, Heer, but the spiral-cells showing 9—10 convolutions.

Occurrence: Secondary, Cretaceous, between Tres Cruces and Negra Muerta (Prov. Jujuy) N. Argentina.

C. perarmata, Stache, 1880 *(nomen nudum).*

C. perarmata, Stache, Verh. Geol. Reichsanst. Wien, 1880, no. 12, p. 199 *(nomen nudum).*
Kosmogyra perarmata, Stache, 1889, p. 134, pl. 4, fig. 3.
See under genus *Kosmogyra.*

C. peritula, Cockerell, 1908.

C. peritula, Cocker. Bull. Amer. Mus. Nat. Hist., XXIV, p. 75 (1908).
Gyrogonites peritulus, Pia, 1927, p. 90.

Remarks: Fruit described as spherical, the spiral-cells showing 6—7 convolutions; no dimensions given. Based apparently upon a single specimen.

Occurrence: Tertiary, ? Miocene, Florissant Shales, Florissant, (Colorado) U. S. A.

C. (Tolypella?) perpusilla, Groves, 1926.

C. (Tolypella?) perpusilla, Groves, in Reid & Chandler, Brit. Mus. Cat. Cainoz. Plants (Bembridge Fl.), p. 173, fig. 20 (1926).

Remarks: Fruit extremely small, ellipsoid, c. 275—300 μ long, 200—250 μ broad, the spiral-cells showing about 12 convolutions. Apparently the smallest Charophyte fruit known from Tertiary deposits.

Occurrence: Tertiary, Oligocene, Bembridge Beds, Whitecliff Bay, (Isle of Wight), England.

C. petrolei, Andreae, 1884.
C. petrolei, Andreae, Abh. Geol. Specialk. Elsass-Lothr., II, 3, p. 162, Atl. pl. 5, fig. 11.
C. petrolei, Andr., Förster, 1913, p. 22, pl. 2, fig. 2.
Gyrogonites petrolei, Pia, 1927, p. 90.
Remarks: Fruit described as oval, 40—500 µ long, 300 µ broad, the spiral-cells showing 8 convolutions.
Occurrence: Tertiary, Oligocene, boring near Oberstritten, Alsace, France.

C. polita, Reid & Groves, 1921.
C. polita, Reid & Grov., Quart. Journ. Geol. Soc., LXXVII, 3, p. 187, pl. 5, fig. 9, 12 (1921).
Gyrogonites politus, Pia. 1927, p. 90.
Remarks: Fruit globose-ellipsoid, tapering slightly below, 675—750 µ long, 625—675 µ broad, spiral-cells showing 8—10 convolutions somewhat swollen at the apex.
Occurrence: Tertiary, Lower Headon Beds, Hordle (Hants.), England.

C. polonica, Unger, 1860.
C. polonica, Unger, Denks. Akad. Wiss. Wien, XIX, p. 3, pl. 2, fig. 1—4. (1860).
C. polonica, Unger, Schimper, 1869, p. 225.
Gyrogonites polonicus, Pia, 1927, p. 89.
Remarks: Fruit described as oval, 710 µ long, 520 µ broad, the spiral-cells showing 8—9 convolutions.
Occurrence: Secondary, Cretaceous, „in calcareo albida" Podhajce, (E. Galicia), Poland.

C. prisca, Unger, 1850.
C. prisca, Unger, 1845, p. 17 *(nomen nudum).*
C. (Nitella?) prisca, Unger, Gen. et sp. Pl. foss., p. 32, (1850).
C. prisca, Unger, 1852, p. 81, pl. 25, fig. 6.
C. prisca, Ung., Schimper, 1869, p. 221.
Remarks: Very imperfect vegetative remains only, an apparently ecorticate stem, with ± whorled lateral processes, which may possibly belong to a Charophyte.
Occurrence: Tertiary, Miocene (Aquitanian), „*in calc-areo-argillaceo*" Radoboj, Yugoslavia.

C. Purbeckensis, Morris, 1854 *(nomen nudum).*
C. Purbeckensis, „Forbes Rec. Geol. Survey p." Morris, Cat. Brit. Foss., ed. 2, p. 5 (1854) nomen nudum.
Remarks: No information has yet come to light as to what was intended by this name.
Occurrence: Secondary, Jurassic, Purbeck Beds, Isle of Purbeck, (Dorset), England.

C. pygmaea, Hartmann, 1907.
C. pygmaea, Hartm. Inaug. Diss., Breslau, p. 19 (1907).
Remarks: Fruit described as ovate, c. 480 µ lang, 370 µ broad, the spiral-cells showing 13 convolutions.
Occurrence: Quaternary, Diluvial, Ingramsdorf, Silesia. In company with remains of existing species of aquatic Phanerogams, and no doubt itself belonging to some living species, though the dimensions given imply an unusually small fruit.

C. quinqueradiata, Hartmann, 1907.
C. quinqueradiata, Hartm. Inaug. Diss., Breslau, p. 20 (1907).

Remarks: Fruit stated to be pyriform. 900 μ long, 700 μ broad, the spiral-cells showing 11 convolutions.

Occurrence: Quaternary, Diluvial, Ingramsdorf, Silesia. In company with remains of existing species of aquatic Phanerogams and no doubt itself belonging to some living species.

C. Rauwi, Leriche, 1928.

C. De Rauwi, Leriche, 1927, p. 59 *(nomen nudum).*

C. Rauwi, Leriche, Ann. Soc. Géol. Belgique. 1926—7, L. (Annexe), II, p. 49, pl. 2, fig. 7—9 (1928).

Remarks: Fruit described as subspherical or slightly oval, the greater diameter 500—700 μ, the spiral-cells showing 8—9 convolutions

Occurrence: Secondary, „Grès polymorphes", Couches du Lubilash, on the boundaries of Congo and Angola, South Africa. The formation is referred by the author to „Triassique supérieur ou Rhétien".

C. Reussiana, Ettingshausen, 1867.

C. Reussiana, Ettingsh. Denks. Akad. Wiss. Wien, XXVI, p. 82, pl. 1, fig. 3—6 (1867).

C. Reussiana, Ettingsh., Schimper, 1869, p. 228.

Gyrogonites Reussianus, Pia, 1927, p. 90.

Remarks: Both vegetative parts and fruits found. Stem described as 1 mm. thick, 8-striate, whorls of 4—7 branchlets, the fruit subglobose, 830 μ long, 720 μ broad, the spiral-cells showing 12—13 convolutions.

Occurrence: Tertiary, Miocene, „Im Polirschiefer von Kutschlin" Bohemia.

C. robusta, Stache, 1880 *(nomen nudum).*

C. robusta, Stache, Verh. Geol. Reichsanst. Wien, 1880, no. 12, p. 199 (nomen nudum).

? *Nitella (Chara) robusta,* Stache, 1889, p. 136, pl. 4, fig. 7.
See genus *Nitella.*

Gyrogonites robustus, Pia, 1927, p. 90.

C. Rochettiana, Heer, 1855.

C. Rochettiana, Heer, Fl. Tert. Helv., I, p. 26, pl. 4, fig. 9, (1855).

C. Rochettiana, Heer, Gaudin, 1854, p. 28.

C. Rochettiana, Heer, Schimper, 1869, p. 224.

Gyrogonites Rochettianus, Pia, 1927, p. 90.

Remarks: Fruit described as „oblongo subcylindrico" 780 μ long, 560 μ broad, the spiral-cells showing 11 convolutions, A marked feature of this type is the very much swollen tips of the spiral-cells, described and figured as being nearly as broad as the fruit.

Occurrence: Tertiary, Miocene, Lignites of Rochette, and Paudex (Vaud) Switzerland.

C. Rollei, Unger, 1858.

C. Rollei, Unger, Denks. Akad. Wiss. Wien, XIV, p. 9, pl. 1, fig. 19—21 (1858).

C. Rollei, Ung., Schimper, 1869, p. 227.

Gyrogonites Rollei, Pia, 1927, p. 90.

Remarks: Fruit described as elliptic, truncate below, but, as Schimper points out, Unger evidently mistook the apex for the base, 840 μ long, 760 μ broad, the spiral-cells showing 7 convolutions.

Occurrence: Tertiary, Miocene, Lignites near Château Thal, Gratz, Austria.

C. Sadleri, Unger, 1850.

C. Sadleri, Unger, Gen. & sp. Pl. foss., p. 36 (1850).

C. Sadleri, Unger, 1852, p. 81, pl. 25, fig. 7—9.
C. Sadleri, Unger, Schimper, 1869, p. 225.
Gyrogonites Sadleri, Pia, 1927, p. 90.
Remarks: Fruit described as oval, 500 μ long, 370 μ broad, the spiral-cells showing 8—9 convolutions.
Occurrence: Tertiary, Miocene, „Terra lignitum", near Oedenberg, Hungary.

C. Salteri, Bosquet, 1859.
C. Salteri, Bosq., Rech. Pal. Terr. Tert. Limbourg Neerland., p. 26, pl. 2, fig. 13 (1859).
Remarks: Fruit described as ovale-elliptique, 900 μ long, 400 μ broad, the spiral-cells showing 10—11 convolutions.
Occurrence: Tertiary, Upper Tongrien, Humkoven, Ulestraten, Limbourg, Holland.

C. Schubleri, Unger, 1850.
C. Schubleri, „Alex. Braun ms." Unger, Gen. & Sp. Pl. foss., p. 35 (1850).
C. Schubleri, Al. Br., Schimper, 1869, p. 227.
Characeites Schubleri, Pia, 1927, p. 89.
Remarks: Remains of stem only found, diameter 400—800 μ, cortex diplostichous, showing 16—20 series (larger and smaller alternating), implying whorls of 8—10 branchlets.
Occurrence: Tertiary, Miocene, Steinheim, Hessen-Darmstadt, Germany.

C. siderolitica, Heer, 1859.
C. siderolitica, „Grepin", Heer, Fl. Tert. Helv., III, p. 149, pl. 141. fig. 107 (1859).
C. siderolitica, Grep., Schimper, 1869, p. 225.
Gyrogonites sideroliticus, Pia, 1927, p. 90.
Remarks: Fruit described and figured by Heer as obovate-pyriform, with obtuse apex, the spiral-cells showing 7—8 convolutions Schimper gives the dimensions as 700 μ long, 500 μ broad. No description by Grepin has been traced, hence the species is here attributed to Heer.
Occurrence: Tertiary, Eocene, Terrain siderolitique, Délémont, N. W. Switzerland.

C. sparnacensis, Watelet, 1866.
C. sparnacensis, Watel. Descr. pl. foss. bass. Paris, p. 54, Atl., pl. 15, fig. 1 (1866).
C. sparnacensis, Watel., Schimper, 1869, p. 229.
C. sparnacensis, Watel., Fritel, 1909, p. 10.
C. sparnacensis, Watel., Dollfus, 1912, p. 825.
C. helicteres, Brongn. var. b. Dollf. & Fritel, 1920, p. 247, fig. 5.
Gyrogonites sparnacensis, Pia, 1927, p. 90.
Remarks: Fruit described as oval with obtuse apex, 1400 μ long, 1180 μ broad, the spiral-cells showing 9 convolutions. Watelet considered his sp. identical with *C. Brongniarti,* Hébert, (non Braun), but the latter would appear to have had a spherical fruit. Dollfus and Fritel treat them as separate varieties of their collective species *C. helicteres.*
Occurrence: Tertiary; Thanétien, Marne de Chenay; Sparnacien, Lignites du Mont Bernon et de Sarran (Marne), France.

C. Springerae, Knowlton, 1902.
C. Springerae, Knowlt. Torreya, II, p. 72, text-fig. (1902).
Gyrogonites Springerae, Pia, 1927, p. 90.

Remarks: Fruit described as elliptical-ovoid 650—700 μ long, c. 400 μ broad, spiral-cells showing 12—13 convolutions.

Occurrence: Quaternary, Pleistocene, Las Vegas, New Mexico, U. S. A.

C. squarrosa, Dollfus & Fritel, 1920.

C. squarrosa, Dollf. & Fritel, Bull. Soc. Géol. France, sér. 4, XIX, p. 249, fig. 10 (1920).

Kosmogyra squarrosa, Pia, 1927, p. 90.

Remarks: Fruit described and figured as irregularly ovoid, 850 μ long, 710 μ broad, the spiral-cells showing 9 convolutions, and furnished on their lower part with a row of roundish irregular tubercles ± regularly spaced and as broad as the diameter of the spiral-cell.

Occurrence: Tertiary, Sparnacien, Marnes et Lignites, Cramant (Marne), Sarron (Oise), France.

var. **crebrinoda,** Dollf. & Fritel, 1920, p. 250, fig. 11.

Remarks: Distinguished from the type by having the spiral-cells furnished with tubercles throughout their length.

Occurrence: From the same localities as the type.

C. Stacheana, Unger, 1860.

C. Stacheana, Unger, Denks. Akad. Wiss. Wien, XIX, p. 3, pl. 1, fig. 1—4 (1860).

C. Stacheana, Unger, Schimper, 1869, p. 229.

Nitella (Chara) Stacheana, Stache, 1889, p. 135, pl. 3, fig. 54, pl. 4. fig. 1, pl. 5, fig. 40 a b.

Gyrogonites Stacheanus Pia, 1927, p. 90.

Remarks: Fruit described as subglobose, 1170 μ long, 1060 μ broad, the spiral-cells showing 7—8 convolutions.

Occurrence: Lowest Tertiary, Liburnian, in several localities near Triest, Northern Italy.

C. Stantoni, Knowlton, 1893.

C. Stantoni, Knowlt. Bot. Gazette, XVIII, 4, p. 141, fig. 1—3 (1893).

C. Stantoni, Knowlt., White, 1895, p. 63, pl. 10, fig. 14—16.

Gyrogonites Stantoni, Pia, 1927, p. 89.

Remarks: Fruit described as oblong-elliptical, rather smaller at the apex, 630 μ long, 480 μ broad, the spiral-cells showing 8—9 convolutions.

Occurrence: Secondary, Upper Cretaceous, Bear River Formation, near Cooksville, Wyoming, U. S. A.

C. stiriaca, Unger, 1860.

C. stiriaca, Unger, Sitz. Akad. Wiss. Wien, XLI, p. 49, pl. 4, fig. 6 (1860).

C. stiriaca, Unger, Schimper, 1869, p. 227.

? *C. stiriaca,* Unger, Heer, 1872, p. 9.

Gyrogonites stiriacus, Pia, 1927, p. 90.

Remarks: Fruit described as subglobose, with obtuse apex, 1100 μ long, 910 μ broad, the spiral-cells showing 5 convolutions.

Occurrence: Tertiary, Miocene, Hundsdorf, near Schonstein, Styria.

C. strobilocarpa, Reid & Groves, 1921.

C. strobilocarpa, Reid & Groves, Quart. Journ. Geol. Soc., LXXVII, 3, p. 187, pl. 5, fig. 7—8 (1921).

Gyrogonites strobilocarpus, Pia, 1927, p. 90.

Remarks: Fruit obovoid tapering below, 850—1000 μ long, 550—600 μ broad, the spiral-cells showing 9—11 convolutions, dilated at the apex.

Occurrence: Tertiary, Lower Headon Beds, Hordle (Hants), England.

var. **ellipsoidea,** Reid & Groves, 1921.

C. strobilocarpa, var. *ellipsoidea,* R. & G., l. c. p. 188, pl. 5, fig. 10.

Remarks: Fruit ellipsoid, tapering slightly at both ends.

Occurrence: With the type, Hordle, Hants.

var. **bitruncata,** Reid & Groves, 1921.

C. strobilocarpa, var. *bitruncata,* R. & G., l. c. p. 188, pl. 5, fig. 13.

Remarks: Fruit bitruncate-ellipsoid, sometimes tapering slightly below.

Occurrence: The same locality as the type.

C. subcylindrica, Reid & Groves, 1921.

C. subcylindrica, Reid & Groves, Quart. Journ. Geol. Soc., LXXVII, 3, p. 187, pl. 5, fig. 4, ? 5.

Gyrogonites subcylindricus, Pia, 1927, p. 90.

Remarks: Fruit ellipsoid-cylindrical, 475—600 μ long, 275—350 μ broad, the spiral-cells showing about 12 convolutions.

Occurrence: Tertiary, Lower Headon Beds, Hordle (Hants), England.

C. subdestructa, Fliche, 1886.

C. subdestructa, Fliche, Bull. Soc. Industr. Mulhouse, LVI, p. 353 (1886).

Remarks: Fragments of stems and branchlets only reported. No adequate description given, merely a comparison with *C. destructa* and *C. Escheri,* differing from the former in the cortical cells not showing a spiral arrangement, from the latter in being much larger. In living species the degree of torsion of the cortical cells is a negligible as a character. On the same individual plant it often happens that on one internode there is considerable torsion, while on another the rows of cells are practically straight.

Occurrence: Tertiary, Oligocene, Mulhouse (Alsace), France.

C. subglobosa, Groves, 1926.

C. subglobosa, Groves, in Reid & Chandler, Brit. Mus. Cat. Cainoz. Plants (Bembridge Fl.), p. 172, pl. 12, fig. 3.

Remarks: Fruit globose-ellipsoid to nearly spherical, 425—475 μ long, 350—400 μ broad, the spiral-cells showing 8—10 convolutions.

Occurrence: Tertiary, Bembridge Beds, Whitecliff Bay, and Hamstead Ledge, (Isle of Wight), England.

C. superba, Stache, 1880 *(nomen nudum).*

C. superba, Stache, Verh. Geol. Reichsanst. Wien, no. 12, p. 199 (1880) nomen nudum.

Kosmogyra (Chara) superba, Stache, 1889, p. 134, pl. 4, fig. 2.

See genus *Kosmogyra.*

C. texensis, Groves, 1925.

C. texensis, Groves, Amer. Journ. Sci., X, p. 13, fig. 2 (1925).

Gyrogonites texensis, Pia, 1927, p. 89.

Remarks: Fruit ellipsoid, ca. 525—600 μ long, 400—450 μ broad, the spiral-cells showing about 12 convolutions.

Occurrence: Secondary, Cretaceous (horizon uncertain), Brewster County, Texas, U. S. A.

C. tomentosa, Linn. 1753, *C. ceratophylla,* Wallr. (Recent)
C. ceratophylla, Bertsch, 1931, p. 84.
Remarks: The living plant occurs in many localities in Germany and elsewhere. The fruit is large, measuring, without the coronula, about 1000 μ in length, 800 μ in breadth.
Occurrence: „Federseerieds", Württemberg Oberland, Germany.

C. tornata, Reid & Groves, 1921.
C. tornata, Reid & Groves, Quart. Journ. Geol. Soc., LXXVII, 3, p. 187, pl. 5, fig. 1—3 (1921).
Gyrogonites tornatus, Pia, 1927, p. 90.
Remarks: Fruit ellipsoid or cylindrico-ellipsoid. c. 550—700 μ long, 400—475 μ broad, the apex somewhat acute, the base truncate, spiral-cells showing about 12 convolutions, slightly swollen at the apex. Oospore present in a few specimens, ellipsoid, apex truncate c. 500—700 μ long, 350—400 μ broad, showing 9—10 rather low ridges.
Occurrence: Tertiary, Lower Headon Beds, Hordle (Hants), England.

C. torulosa, Dollfus & Fritel, 1920.
C. torulosa, Dollf. & Fritel, Bull. Soc. Géol. France, sér. 4, XIX, p. 249, fig. 9 a b (1920).
Gyrogonites torulosus, Pia, 1927, p. 90.
Remarks: Fruit described as ovoid (figured as ellipsoid) → 1000 μ long, 850 μ broad, spiral-cells showing 6—7 very convex convolutions.
Occurrence: Tertiary, Sparnacien, Cramont (Marne), Sarran (Oise), France.

var. **disjuncta,** Dollf. & Fritel, l. c. p. 249, fig. 9 c.
Remarks: Fruit described as much smaller than the type, and having the sutures between the spiral-cells broad and concave.
Occurrence: The same as that of the type.

C. Tournoueri, Dollfus, 1877.
C. Tournoueri, Dollf. Bull. Soc. Géol. France, sér. 3, V, p. 314, fig. 1 (1877).
C. Tournoueri, Dollf., Harris & Burrows 1891, p. 33.
C. Tournoueri, Dollf., Dollf. & Fritel, 1920, p. 256, fig. 18 [a].
Gyrogonites Tournoueri, Pia, 1927, p. 90.
Remarks: Fruit described as oval oblong, slightly narrowed at apex, 720—750μ long, 500—520μ broad, spiral-cells showing 8—9 convolutions.
Occurrence: Tertiary: Sannoisien, Romainville, Montreuil (Seine), Frepillon (Seine et Oise), France.

var. **Thevallensis,** Dollf. 1921. Bull. Soc. Geol. Min. Bretagne, II, I, p. 89, fig. 8.
Remarks: Distinguished from the type by the fruit being subspherical, less attenuated at both extremities.
Occurrence: Marnes Oligocènes, Thévalles, near Laval (Mayenne), France.

C. truncata, Hartmann, 1907.
C. truncata, Hartmann, Inaug. Diss., Breslau, p. 20 (1907).
Remarks: Fruit described as subglobose, c. 1260 μ long, 1040 μ broad, the apex and base truncate, the spiral-cells showing 6—7 convolutions.
Occurrence: Quaternary, Diluvial Beds, Ingramsdorf, Silesia. See remarks under *C. quinqueradiata.*

C. tuberculata, Lyell, 1826.

C. tuberculata, Lyell, Trans. Geol. Soc., ser. 2, II, p. 94, pl. 13, fig. 7—8.
C. „tuberculosa" Lyell, Ad. Brongn. 1828, p. 71.
C. „tuberculosa", Lyell, Unger, 1845, p. 16.
C. tuberculata, Lyell, Unger, 1850, p. 33.
C. tuberculata, Forbes, 1853, p. 267.
C. tuberculata, Lyell, Salter 1856, pp. 159—161, pl. 7, fig. 11—13.
C. tuberculata, Lyell, var. ?, Heer, 1862, p. 376.
C. tuberculata, Lyell, Schimper, 1869, p. 222.
C. tuberculata, Lyell, Dollfus, 1897, p. 605.
C. Archiaci, Watel., var. tuberculata, Dollf. & Iritel, 1920, p. 252.
C. tuberculata, Lyell, Groves, 1926, p. 170, fig. 17, pl. 12, fig. 1.
Kosmogyra tuberculata, Pia, 1927, p. 90.

Remarks: Fruit described as nearly spherical, having the spiral cells ornamented by a row of obtuse tubercles very regularly disposed. Lyell's figure shows 11 convolutions. Unger gives the measurements as 1400 µ long, 1200—1300 µ broad.

Occurrence: Tertiary. England: Oligocene, Bembridge Beds; Whitecliff Bay (Isle of Wight); Hamstead Beds, Hamstead (Isle of Wight): France: Epernay (Marne), Schimper. Marinesien; Marnes du Calcaire de S. Ouen, Perran-Vaucluse (Seine-et-Oise). Austria: Schönck, near Eibiswald, Styria.

var. **Morrisii,** Salter, 1856, p. 159, pl. 7, fig. 14.

Remarks: Fruit described as oblong, tubercles obscure, corona prominent.

Occurrence: Tertiary, Oligocene, Hamstead Beds, Hamstead, (Isle of Wight), England.

C. turbinata, Reid & Groves, 1921.

C. turbinata, Reid & Groves, Quart. Journ. Geol. Soc., LXXVII, 3, p. 188, pl. 6, fig. 1 (1921).
Gyrogonites turbinatus, Pia, 1927, p. 90.

Remarks: Fruit obovoid. apex flattened, tapering towards the base, 625—650 µ long, 400—450 µ broad, spiral-cells showing 9—10 convolutions.

Occurrence: Tertiary, Lower Headon Beds, Hordle (Hants), England.

C. Ungeri, Ettingshausen, 1872.

C. Ungeri, Ettingsh. Denks. Akad. Wiss. Wien, XXXII, p. 162 (1872).
Gyrogonites Ungeri, Pia, 1927, p. 90.

Remarks: Fruit described as oblong-oval, rather acute at each extremity. 1200 µ long, 950 µ broad, the spiral-cells showing 13 convolutions. Ettingshausen founded this species on the specimen figured by Unger, Iconogr. 1852, pl. 25, fig. 10, which Ettingshausen considered to be distinct from the other specimens figured as *C. Meriani.*

Occurrence: Tertiary, Oligocene, Sagor, Krain, Yugoslavia.

C. Valdensis, Morris, 1854, nomen nudum.

C. Valdensis „Forbes, Rec. Geol. Survey, p.", Morris, Cat. Brit. Foss. ed. 2, p. 5 (1854) *nomen nudum.*

Remarks: No information has yet come to light as to what was intended by this name.

Occurrence: Secondary, Wealden, Isle of Purbeck (Dorset), England).

C. variabilis, Andreae, 1884.

C. variabilis, Andreae, Abh. Geol. Specialk. Elsass-Lothr., II, 3, p. 145, Atl. pl. 5, fig. 10 (1884).

Gyrogonites variabilis, Pia, 1927, p. 90.

Remarks: Fruit described as 400—600 μ long, 200—350 μ broad. The shape of the fruit as described and figured by the author is remarkably variable, „bald annähernd kugelig, häufiger länglich oval, elliptisch, spindelförmig, flaschenförmig oder sogar walzenförmig". From the analogy of living species it might be inferred that the different shapes represented different stages in the growth of the oogonia, but against this view it appears that the number of convolutions visible (7—8) is the same in the very narrow as in the broadest fruits, moreover it is very unusual for any but fairly mature fruits to be preserved as fossils.

Occurrence: Tertiary, Lower Oligocene, Pechelbronn, (Alsace), France.

C. vasiformis, Reid & Groves, 1921.

C. vasiformis, Reid & Groves, Quart. Journ. Geol. Soc., LXXVII, 3, p. 185, pl. 4, fig. 12—15 (1921).

C. vasiformis, Reid & Groves, Groves, 1926, p. 171, pl. 12, fig. 9.

Kosmogyra vasiformis, Pia, 1927, p. 90.

Remarks: Fruit obovoid, usually tapering downwards to a pentagonal base, the spiral-cells showing 10—12 convolutions, and furnished with a row of truncate tubercles. Varying considerably in size, 750—950 μ long, 475—725 μ broad. Resembling *C. tuberculata,* Lyell, but smaller and rather obovoid than ellipsoid.

Occurrence: Tertiary, Lower Headon Beds, Hordle (Hants), England; Bembridge Beds, Saltmead Ledge, (Isle of Wight), England.

C. vectensis, Groves, 1926.

C. vectensis, Groves, in Reid & Chandler, Brit. Mus. Cat. Cainoz. Plants (Bembridge Fl.), p. 172, fig. 19, pl. 12, fig. 2, 8.

Remarks: Fruit ellipsoid, very variable in size, and shape, 800—1000 μ long, 500—800 μ broad, the spiral-cells showing 9—10 convolutions, usually swollen at the apex.

Occurrence: Tertiary, Oligocene, Bembridge Beds, Saltmead Ledge and Whitecliff Bay (Isle of Wight), England.

C. vespiformis, Groves, 1926.

C. vespiformis, Groves, in Reid & Chandler, Brit. Mus. Cat. Cainoz. Plants (Bembridge Fl.), p. 171, fig. 18, pl. 12, fig. 5, 7 (1926).

Remarks: Fruit elongate-obovoid, slightly narrowed above to a truncate apex, narrowed gradually downwards to a small rather acute base, c. 700—800 μ long, 425—500 μ broad, spiral-cells showing 12—13 convolutions.

Occurrence: Tertiary, Oligocene, Bembridge Beds. Bembridge Foreland and Saltmead Ledge (Isle of Wight), England.

C. Voltzii, Unger, 1850.

C. Voltzii, „Alex. Braun ms.", Unger, Gen. & sp. Pl. foss., p. 34, (1850).

C. Voltzii, Al. Braun, Schimper, 1869, p. 226, Atl. (1874) pl. 5, fig. 56—58.

Gyrogonites Voltzii, Pia, 1927, p. 90.

Remarks: Fruit described as oblong-ovate slightly broader above 580—620 μ long, 380—420 μ broad, the spiral-cells showing 10 convolutions. Schimper records the presence of remains of the oospore, and of small fragments of stem.

Occurrence: Tertiary, Upper Eocene?, „*in stagnigena marga lignitum*", Lobsann (Alsace), France.

C. vulgaris, Linn. 1753, *C. foetida,* Braun. (Recent.)

C. vulgaris, Schlotheim, 1832, p. 3; Sternberg, 1825, p. XXXI.
C. foetida, Al. Br., Unger, 1850, p. 36.
?*C. vulgaris,* Sharp, 1868, p. 563.
C. foetida, Al. Br., Schimper, 1869, p 232.
C. foetida, Al. Br., Fliche, 1883, p. 15.
C. foetida, Al. Br., Nathorst, 1891, p. 20.
c. f. *C. foetida,* Al. Br., Weber, 1908, p. 43.
C. foetida, Al. Br. Brockman-Jerosch, 1910, p. 180.

Remarks: This species is world-wide in its distribution, and may therefore be expected to occur in many fresh- and brackish-water beds of the more recent formations.

Occurrence: All the above records refer to very late deposits, and some can hardly be regarded as fossil.

C. Werneri, Hartmann, 1907.

C. Werneri, Hartm. Inaug. Diss., Breslau, p. 11 (1907).

Remarks: Fruit described as subglobose, 840 μ long, 720 μ broad, truncate below, the spiral-cells showing 7 convolutions, with their apex prominent.

Occurrence: Quaternary. Diluvial beds, Ingramsdorf, Silesia, in company with the remains of living Phanerogams, and probably belonging to some existing species.

C. Woodringi, Berry, 1922.

C. Woodringi, Berry, Proc. U. S. Nat. Hist. Mus., LXII, 14, p. 3, fig. 1 (1922).
Gyrogonites Woodringi, Pia, 1927, p. 90.

Remarks: Fruit described as elliptical in profile, varying in length from 750 to 1250 μ, in diam. from 500 to 800 μ, and figured as tapering somewhat at both extremities, the spiral-cells showing about 16 convolutions.

Occurrence: Tertiary, Miocene, Haiti, West Indies.

C. Wrightii, Salter, 1856.

C. Wrightii, Forbes, Morris, 1854, p. 5 *(nomen nudum).*
C. Wrigthii „Forbes mss", Salter, Mem. Geol. Surv., Tert. Fluv. Mar. Form. I. of Wight pp. 159—161, pl. 7, fig. 15—21 (1856).
C. Wrightii, Forbes, Seward, 1898, p. 227, fig. 46 de.
C. Wrightii, Salter, Reid & Groves, 1921, p. 183, pl. 4, fig. 1.
Gyrogonites Wrightii, Pia, 1927, p. 90.

Remarks: Fruit described as globular or somewhat elliptical, the spiral-cells showing 5—7 convolutions. As Salter suggests (l. c.) this is probably referable to *C. medicaginula.*

Occurrence: Tertiary, Lower and Middle (bottom layer), Headon Beds, Isle of Wight and Hordle (Hants), England.

var. **rhytidocarpa,** Reid & Groves, 1921 (l. c.), p. 184, pl. 4, fig. 3.

Remarks: Distinguished from the type by the unequal and angular spiral-cells, which the authors thought may be due to abnormality.

Occurrence: With the type at Hordle and the Isle of Wight.

var. **minor,** Reid & Groves, 1921 p. 184, pl. 4, fig. 2.

Remarks: Distinguished only by the size, 750—850 μ as compared with that of the type, i. e. 950—1100 μ. Probably identical with var. *minor* of *C. medicaginula.*

Occurrence: With the type, Hordle, Hants.

C. Zietheni, Unger, 1850.

C. Zietheni, „Alex. Braun ms." Unger, Gen. & sp. Pl. foss., p. 35 (1850).

Characeites Zieteni, Pia, 1927, p. 89.

Remarks: Stems only found, and described as about 500 μ in diam. with 24 series of cortical-cells of equal diameter, which may be laken to imply its being triplostichous, and perhaps identical with the very widely distributed living species, *C. fragilis,* Desv.

Occurrence: Tertiary; Miocene, Steinheim, Hessen-Darmstadt, Germany.

C. Zoberbieri, Fritsch, 1885.

C. Zoberbieri, Fritsch, Jahrb. Preuss. Geol. Landesanst., 1884, p. 424, pl. 26, fig. 2—5 (1885).

Gyrogonites Zoberbieri, Pia, 1927, p. 90.

Remarks: Fruit described as nearly spherical, 620—650 μ long, 550—560 μ broad, the spiral-cells showing 8 convolutions.

Occurrence: Tertiary, Pliocene, Gera, Thuringia, Germany.

C. Zolleriana, Heer, 1855.

C. Zolleriana, Heer, Fl. Tert. Helv. I, p. 27, pl. 3, fig. 10 (1855).

C. Zolleriana, Heer, Schimper, 1869, p. 228.

C. Zolleriana, Heer, Engel, 1908, p. 565.

Characeites Zollerianus, Pia, 1927, p. 89.

Remarks: Vegetative parts only found. Stem. c. 1000 μ in diameter, branchlets 6 in number, stem-cortex diplostichous, the primary and secondary series of equal diameter.

Occurrence: Tertiary, Miocene, Oeningen, Switzerland; Upper Miocene, Steinheim, Württemburg (Engel). Recorded by Pia from the Eocene (1927).

Characeites, Tuzson, 1913.

Characeites, Tuzson, Adal. Magyar. Foss. Flor. Ungar. Magyar. Foldt. XXI, 8, p. 209, pl. 13, 1913; Mitt. Jahrb. Ungar. Geol. Reichsanst. XXI, 8, p. 233, pl. 13, 1914.

A genus originated to include fossil remains of *Charophyta,* the genera of which cannot be determined.

C. acuminata, Tuzson, 1913.

C. acuminata, Tuzson, l. c. p. 210, pl. 13, fig. 3, 1913.

Gyrogonites acuminatus, Pia, 1927, p. 90.

Remarks: Fruit described as ovate-oblong, acuminate at both ends, 610—700 μ long, 440—530 μ broad, the spiral-cells showing 10 convolutions.

Occurrence: Tertiary, Eocene, Kesd, Central Hungary.

C. globosa Tuzson, 1913.

C. globosa, Tuzson, l. c. p. 210, pl. 13, fig. 2, 1913.

Gyrogonites globosus, Pia, 1927, p. 90.

Remarks: Fruit described as globose or subglobose, obtuse at both ends, 770—800 μ long, 730—800 μ broad, the spiral-cells showing 6 convolutions.

Occurrence: Tertiary, Upper Eocene, Stazsa, near Esztergem, West Hungary.

C. verrucosa, Tuzson, 1913.

C. verrucosa, Tuzson, l. c. p. 210, pl. 13, fig. 1, 1913.

Kosmogyra verrucosa, Pia, 1927, p. 90.

Remarks: Fruit described as subglobose or globose, obtuse at both ends, 1050—1100 μ long, 950—1050 μ broad, the spiral-cells showing 7 convolutions, with closely set tubercles. The latter are figured as very broad and irregular in shape.

Occurrence: Tertiary, Upper Eocene, Strazsa, near Esztergom, West Hungary.

CHARACEITES „Tuzson" Pia, 1927, p. 89, non Tuzson (nomina generica et specifica irrita).

As will be seen from the foregoing, Prof. Pia has transferred the three species, on which Tuzson founded the genus, to *Gyrogonites* and *Kosmogyra*. He makes use of the generic name *Characeites* for fossil Charophytes with corticate stems but of which only vegetative parts are found. Such a course would have been appropriate, and quite in order, had not the name been already taken up by Tuzson for a different purpose. It must therefore, in Pia's sense be set aside. The names given by the latter author are as follows:

(l. c. 1927, p. 89)

Characeites Blassianus, Pia, = *Chara Blassiana*, Heer.
„ *?fyeensis*, Pia, = *Chara fyeensis*, Crié
„ *minimus*, Pia, = *Chara minima*, Sap.
„ *Schubler*, Pia, = *Chara Schubleri*, „Braun" Unger.
„ *Zieteni*, Pia, = *Chara Zietheni*, „Braun" Unger.
„ *Zollerianus*, Pia, = *Chara Zolleriana*, Heer.]

Clavator, Reid & Groves, 1916.

Clavator, Reid & Groves, Proc. Roy. Soc. B. LXXXIX, p. 253. 1916.

This very distinct genus presents the following outstanding characters:

1) The oogonia are enclosed in an outer utricle, a condition not found in any other type of Charophyte. Possibly the curious bodies described and figured by Saporta (1891), under the name of Chara Maillardi, may be the utricles of a species of Clavator.
2) The stem-cortex, which is diplostichous, is always composed of twelve series of cells, which in the central part of the internode are of equal size, but, as they approach the nodes, six of them (the primary series) rapidly increase in diameter, becoming more than five times that of the cells of the secondary series, which lie in the outer sutures between the primary rows. Sections of different parts of the stem, showing the features referred to, were figured by Wethered (1890), but it was not until Reid etched out the remains that it became apparent that they were parts of the stem of the same species.
3) The cortical cells of the stem, and the branchlets, produce groups of clavate protuberances, unlike the spine-cells of living Charae in that they are not separate cells.

The only species yet discriminated is:

C. Reidii, Groves, 1924.
C. Reidii, Groves, Journ. Bot. LXII, p. 116, 1924.
C. Reidii, Groves, Pia, 1927, p. 91.

Remarks: Characters of the genus.

Occurrence: Secondary, Jurassic, Middle Purbeck Beds, near Weymouth, Lulworth and Swanage (Dorset), England.

Cristatella, Stache, 1889.

CRISTATELLA, Stache, Abhandl. Geol. Reichsanst. XIII, 1, p. 131, 1889.

A genus originated as a section of Nitelleae, to include species having the spiral-cells of the oogonium concave, with a grooved ridge between. In the genus, Stache included the fossil Chara sparnacensis, Watel, and the living Australian species Nitella cristata, Braun, the latter apparently under a misconception as to the conformation of its fruit, which does not differ in any important particular from those of other Nitellae. He did not however publish either of these names under his new genus. The concavity of the spiral-cells in the fossil fruits is no doubt due, as it is in those of living species when the fruits have become dry, to a feeble development of the lime-shell, and the groove in the ridges merely to the ordinary suture between the spiral-cells, the slight double curve in the latter being brought about in the course of shrinkage. These conditions are observable in other types.

The only species described is:

Cristatella doliolum, Stache, 1889.

Chara doliolum, Stache, 1880, p. 199, *nomen nudum.*
Cristatella doliolum, Stache, Abhandl. Geol. Reichsanst. Wien, XIII, 1, p. 136, pl. 4, fig. 8 (1889).
Gyrogonites doliolum, Pia, 1927, p. 89.

Remarks: Fruit described as 1000—1200 μ long, 700—900 μ broad, the spiral-cells showing about 7 concave convolutions, with prominent grooved ridges between.

Occurrence: Lowest Tertiary, Liburnian, in the neighbourhood of Corgnale, near Triest.

Gyrogona (or **Gyrogonites),** Lamarck, 1804.

GYROGONA (or GYROGONITES), Lamarck, Ann. Mus. Nat. Hist. (Paris), V, p. 355, 1804.

Lamarck included this genus among the Mollusca, but with an element of doubt, drawing attention to the resemblance of the „*Gyrogonites*" to the fruit of Luzerne *(Medicago sativa).* In the first reference he uses the generic name „*Gyrogona*", with a latin diagnosis, but in the same paper, p. 356, he writes it „*Gyrogonites*". „*Gyrogona*" appears again as well as „*Gyrogonites*" in his publication of 1822, where he also trears it as a mollusc, although in 1812 Leman had identified it as the fruit of a charophyte.

Gyrogonites medicaginula Lamarck, 1804.

Gyrogonites medicaginula, Lamarck, 1804, l. c. p. 356.
Gyrogonites medicaginula, Lamarck, 1807, pl. 17, fig. 7.
Gyrogonites medicaginula, Lamarck, 1822, p. 614.
Chara medicaginula, Ad. Brongniart, 1822, p. 320, pl. 17, fig. 5.

For further synonymy and other particulars see under genus *Chara.*

Prof. Pia (1927; pp. 89—90) has transferred to this genus most of the fossil species previously placed under *Chara,* also two species of *Characeites,* two of *Nitella,* and the one *Cristatella,* as shown below. For synonymy, remarks, and occurrence, see the several genera in question.

G. acuminatus, Pia. = Characeites acuminata, Tuzson.
G. Anoplotheriorum, Pia. = Chara anoplotheriorum, Sap.
G. aragonensis, Pia. = C. aragonensis, Unger.
G. Archiaci, Pia. = C. Archiaci, Watel.
G. Bernoullii, Pia. = C. Bernoullii, Unger.
G. brewsterensis, Pia. = C. brewsterensis, J. Groves.
G. Brongniarti, Pia. = C. Brongniarti, Unger.
G. compressus, Pia. = C. compressa, Knowlt.
G. cosinensis, Pia. = C. cosinensis, Stache.
G. crassus, Pia. = C. crassa, Dollf. & Frit.
G. depressus, Pia. = C. depressa, Watel.
G. devestitus, Pia. = C. devestita, Stache.
G. distortus, Pia. = C. distorta, Reid & Groves.
G. doliolum, Pia. = Cristatella doliolum, Stache.
G. elegans, Pia. = Chara elegans, Dollf. & Frit.
G. Escheri, Pia. = C. Escheri, Unger.
G. Gardnerae, Pia. = C. Gardnerae, J. Groves.
G. globosus, Pia. = Characeites globosa, Tuzson.
G. globulus, Pia. = ?Nitella globulus, Stache.
G. granulifer, Pia. = Chara granulifera, Heer.
G. helicteres, Pia. = C. helicteres, Ad. Brongn.
G. inconspicuus, Pia. = C. inconspicua, Unger.
G. Jaccardi, Pia. = C. Jaccardi, Heer.
?G. Knowltoni, Pia. = C. Knowltoni, Seward.
G. laevigatus, Pia. = C. laevigata, Upton.
G. Langeri, Pia. = C. Langeri, Ettingsh.
G. Lemanii, Pia. = C. Lemani, Ad. Brongn.
?G. liassicus, Pia. = C. liassica, Moore, nomen nudum.
G. Lyellii, Pia. = C. Lyelli, Unger.
G. Malcolmsonii, Pia. = C. Malcolmsonii, Sower.
G. Meriani, Pia. = C. Meriani, Unger.
G. peritulus, Pia. = C. peritula, Cocker.
G. petrolei, Pia. = C. petrolei, Andr.
G. politus, Pia. = C. polita, Reid & Groves.
G. polonicus, Pia. = C. polonica, Unger.
G. Reussianus, Pia. = C. Reussiana, Ettingsh.
G. robustus, Pia. = C. robusta, Stache.
G. Rochettianus, Pia. = C. Rochettiana, Heer.
G. Rollei, Pia. = C. Rollei, Unger.
G. Sadleri, Pia. = C. Sadleri, Unger.
G. siderolitícus, Pia. = C. siderolitica, Heer.
G. sparnacensis, Pia. = C. sparnacensis, Watel.
G. Springerae, Pia. = C. Springerae, Knowlt.
G. Stacheanus, Pia. = C. Stacheana, Unger.
G. Stantoni, Pia. = C. Stantoni, Knowlt.
G. stiriacus, Pia. = C. stiriaca, Unger.
G. strobilocarpus, Pia. = C. strobilocarpa, Reid & Groves.
G. subcylindricus, Pia. = C. subcylindrica, Reid & Groves.
G. subimpressus, Pia. = Nitella subimpressa, Stache.
G. texensis, Pia. = Chara texensis, J. Groves.
G. tornatus, Pia. = C. tornata, Reid & Groves.
G. torulosus, Pia. = C. torulosa, Dollf. & Frit.
G. Tournoueri, Pia. = C. Tournoueri, Dollf.
G. turbinatus, Pia. = C. turbinata, Reid & Groves.
G. Ungeri, Pia. = C. Ungeri, Ettingsh.
G. variabilis, Pia. = C. variabilis, Andr.
G. Voltzii, Pia. = C. Voltzii, Unger.
G. Woodringi, Pia. = C. Woodringi, Berry.
G. Wrightii, Pia. = C. Wrightii, Salter.
G. Zoberbieri, Pia. = C. Zoberbieri, Fritsch.

Kosmogyra, Stache, 1889.

Kosmogyra, Stache, Abhandl. Geol. Reichsanst. Wien, XIII, 1, p. 130 (1889).

Kosmogyra, Stache. Pia, 1927, p. 90.

A genus placed by Stache in his group Kosmogyreae, characterised by the fruits being more or less globular, and the spiral-cells being „decorated", and separated from the other genus in the group, *Kosmogyrella,* by the spiral-cells being flat or convex.

The precise nature and significance of the „decoration" of the spiral-cells is problematic. It has no equivalent in living species; that is if it is really part of the fruit. It consists of more or less evenly-spaced prominences, varying considerably in form.

When, as is the case in several species, the prominences are irregular in shape, sometimes merging together to form a continuous ridge, sometimes appearing to form an uneven double row, the suggestion presents itself that they may merely represent an interrupted incrustation. This view is supported by the occurrence on a living species (Chara delicatula, Ag.) of an interrupted calcareous incrustation closely resembling the supposed tubercles on some of the fossils. Moreover in one fossil species *(C. squarrosa;* Dollf. & Frit., type) the tubercles extend only part of the way along the spiral-cells. It is also a significant fact that where tuberculate fruits are found, there are often others almost exactly similar without any „decoration".

On the other hand, in many of the species enumerated below, the prominences are so evenly spaced, so symmetrical, and so definite in shape, as to seem to preclude the possibility of their being merely due to external incrustation. Moreover the investigation undertaken in connexion with fruits of an Oligocene species, recorded by Reid & Groves, 1921, p. 185, went to show that the substance of the prominences was at any rate partially organic. The question requires further investigation.

In three species figured by Stache, *K. acanthica, K. ornata,* and *K. perarmata,* the prominences on the spiral-cells ± coincide with one another in position on the different cells, giving the impression that the fruit has interrupted ridges. The relative position of the prominences in neighbouring spiral-cells must be ± fortuitous and their coincidence has perhaps been somewhat exaggerated in the drawings. These representations of apparently ribbed fruits evidently led Karpinski to regard Sycidium as a possible member of the same group. Admirable as Stache's drawings are from an artistic point of view, it is to be feared that he sometimes allowed too much play to his imagination!

In the figures of *K. superba, K. perarmata,* and *K. ornata,* a five-pointed star-like depression is shown in the end-view of the fruits, purporting to represent the apex. These pentagonal depressions are associated by the author with coronula cells. Their close resemblance however to the appearance of the extremities of the spiral-cells as they surround the *basal* orifice of the fruits, where the stalk-cells is inserted, (as shown in Eocene and Oligocene fruits) seems to point clearly to the base, and not the apex, being depicted in the figures. Moreover the pattern made by the meeting of the five apical extremities of the spiral-cells in all other speceis does not correspond with the figures.

In addition to the species of *Kosmogyra* of which figures and descriptions were published by Stache, there are a number of others drawn but apparently not described, among the ms. and specimens left by the author.

K. acanthica, Stache, 1889.

Chara acanthica, Stache, 1880, p. 199, *nomen nudum.*

K. (Chara) acanthica, Stache, l. c. p. 135, pl. 4, fig. 5 (1889).

Remarks: Fruit described as 1000 μ long, 800 μ broad. Spiral-cells represented as showing 7 convolutions, the prominences sharp, rather wide apart, and nearly coinciding in position in all the cells, giving the impression of the fruit being ridged, longitudinally.

Occurrence: Tertiary, Lowest Liburnian, Corgnale, near Triest, N. E. Italy.

K. Bleicheri, Pia, 1927.

Chara Bleicheri, Saporta, 1873 (2), p. 214, Atl. pl. 9, fig. 8—11.
K. Bleicheri, Pia, 1927, p. 90.
For remarks etc. see *Chara.*

K. caelata, Pia, 1927.

Chara caelata, Reid & Groves, 1921, p. 184, pl. 4, fig. 4—10.
K. caelata, Pia, l. c. p. 90.
See under *Chara.*

K. cingulata, Stache, 1889.

Chara cingulata Stache, 1880, p. 198, *nomen nudum.*
K. (Chara) cingulata, Stache, l. c. p. 121, pl. 2, fig. 20.
Remarks: Fruit nearly spherical, with a diameter of 1000—1200 μ, the spiral-cells, represented as horizontal, showing 7 convolutions, with a strong rounded longitudinal ridge, showing very slight indications of interruptions. The depiction of the spiral-cells as horizontal can hardly be correct.

Occurrence: Lowest Tertiary, Liburnian, Cosina, near Triest, N. E. Italy.

K. ? destructa, Pia, 1927.

Chara destructa, Saporta, 1861, p. 156, *nomen nudum.*
C. destructa. Saporta, 1863, p. 9.
K. ? destructa, Pia, l. c. p. 90.
See under *Chara.*

K. Dutemplei, Pia, 1927.

Chara Dutemplei, Watelet, 1866, p. 56, pl. 15, fig. 6.
K. Dutemplei, Pia, l. c. p. 90.
See under *Chara.*

K. Grepini, Pia, 1927.

Chara Grepini, Heer, 1859, p. 150, pl. 141, fig. 108—109.
K. Grepini, Pia, l. c. p. 90.
See under *Chara.*

K. guttifera, Stache, 1889.

Chara guttifera, Stache, 1880, p. 199, *nomen nudum.*
K. guttifera, Stache, 1889, p. 134, pl. 4, fig. 6

Remarks: Fruit represented as very broadly ellipsoid nearly spherical, 800—1000 μ long, 700—900 μ broad, the spiral-cells showing 8 convolutions, with large rounded boss-like projections.

Occurrences: Lowest Tertiary, Liburnian, Corgnale, near Triest, N. E. Italy.

K. Nielfalensis, Pia, 1927.

Chara Nielfalensis, Dollf. & Frit. 1920, p. 250, fig. 12.
K. Nielfalensis, Pia, l. c. p. 90.
See under *Chara.*

K. onerata, Pia, 1927.
Chara onerata, Watelet, 1866, p. 56, pl. 15, fig. 2.
K. onerata, Pia, l. c. p. 90.
See under *Chara.*

K ornata, Stache, 1889.
Chara ornata, Stache, 1880, p. 199, *nomen nudum.*
K. (Chara) ornata, Stache, 1889, p. 134, pl. 4, fig. 4.

Remarks: Fruit nearly spherical, 800—1000 μ long, 700—900 μ broad, the spiral-cells showing 7 convolutions. The „decoration" is represented as consisting of broad somewhat rounded prominences, narrowly spaced, and nearly coinciding in position in the different cells so as to give an impression of the fruit being longitudinally ridged.

Occurrence: Lowest Tertiary, Liburnian, from several localities near Triest, N. E. Italy.

K. perarmata, Stache, 1889.
Chara perarmata, Stache, 1880, p. 199, *nomen nudum.*
K. (Chara) perarmata, Stache, 1889, p. 134, pl. 4, fig. 3.

Remarks: Fruit large, represented as nearly spherical, 1200—1400 μ long, 1100—1300 μ broad, the spiral-cells showing 9—10 convolutions. The decoration consists of closely-placed sharp-pointed prominences, ± coinciding in position in the different cells, thereby giving the impression that the fruit is longitudinally ridged.

Occurrence: Lowest Tertiary, Liburnian, Corgnale, near Triest, N. E. Italy.

K. squarrosa, Pia, 1927.
Chara squarrosa, Dollf. & Frit., 1920, p. 249, fig. 10—11.
K. squarrosa, Pia, l. c. p. 90.
See under *Chara.*

K. superba, Stache, 1889.
Chara superba, Stache, 1880, p. 199, *nomen nudum.*
K. superba, Stache, 1889, p. 134, pl. 4, fig. 2.
K. superba, Stache, Pia, 1927, p. 90, fig. 74.

Remarks: Fruit represented as very large, ellipsoid, with somewhat flattened extremities, 1800—2000 μ long, 1600 μ broad, the spiral cells showing 10 convolutions, with closely-placed round boss-like prominences. The dimensions given are much in excess of those of any other species.

Occurrence: Lowest Tertiary, Liburnian, Divacca, near Triest,

K. tuberculata, Pia, 1927.
Chara tuberculata, Lyell, 1826, p. 94, pl. 13, fig. 7—8.
K. tuberculata, Pia, l. c. p. 90.
See under *Chara.*

K. vasiformis, Pia, 1927.
Chara vasiformis, Reid & Groves, 1921, p. 185, pl. 4, fig. 12—15.
K. vasiformis, Pia, l. c. p. 90.
See under *Chara.*

K. verrucosa, Pia, 1927.
Characeites verrucosa, Tuzson, 1913, p. 210, pl. 13, fig. 1.
K. verrucosa, Pia, l. c. p. 90.
See under *Chara.*

Kosmogyrella, Stache, 1889.

Kosmogyrella, Stache, Abhandl. Geol. Reichsanst. XIII, 1, p. 130 (1889).

A genus of the author's section *Kosmogyreae,* distinguished from Kosmogyra by the spiral-cells being concave, and the ridges between them being grooved, a parallel distinction to that relied upon to separate *Cristatella* from *Nitella,* and doubtless brought about under similar conditions.

K. carinata, Stache, 1889.

Chara carinata, Stache, 1880, p. 198, *nomen nudum.*

? Kosmogyrella (Chara) carinata, Stache, 1889, l. c. p. 121, pl. 2, fig. 19.

Remarks: Fruit described by the author as broader than high, with a diameter of ca. 1000 μ, the spiral-cells showing 5 convolutions. The very unsatisfactory figure shows 4 strong ridges with faint suggestions of „decoration", and being quite parallel infers rings instead of spirals.

Occurrence: Lowest Tertiary, Liburnian, Cosina, near Triest, N. E. Italy.

K. undulata, Pia, 1927.

Chara Archiaci var. *undulata,* Dollf. & Frit. 1920, p. 252, fig. 14.

K. undulata, Pia, l. c., p. 90.

See under *Chara.*

Lagynophora, Stache, 1880.

Lagynophora, Stache, Verh. Geol. Reichsanst. XII, 1, p. 198, 1880, Abhandl. Geol. Reichsanst. Wien, XIII, 1, p. 130, 1889.

A remarkably distinct genus, characterised by the fruit being flask-shaped. the lower part being nearly globular and the spiral-cells prolonged upwards into a cylindrical neck. The vegetative parts are well preserved, and unlike those of any other fossil Charophytes the fruits are usually found attached to the branchlets, and the whorls are entire, so that a better idea of the general structure and habit of the plant can be obtained than in the case of any other type. The plant was evidently minute, as the fruiting whorls were apparently not much more than 3 mm. in diameter. The stem was corticate, and the oogonia, except in sp. 5, were terminal.

The five species enumerated are apparently closely allied. All were collected in the Liburnian (Lowest Tertiary) Beds, at Corgnale, near Triest, N. E. Italy, and *L. foliosa* also at Gaberg, in the same district.

The species are apparently differentiated as follows:

a) Primary rays of fertile whorls one-jointed, much broadened upwards, secondary rays simple, shorter than the oogonia.

1) **L. liburnica,** Stache, 1880.

L. liburnica, Stache, Verh. Geol. Reichsanst. Wien, XII, p. 199, 1880. Abhandl. Geol. Reichsanst. Wien, XIII, I, p. 132, pl. 4, fig. 9 & 14, 1889.

L. liburnica, Stache, Zeiller, 1900, p. 36, fig. 10.

L. liburnica, Stache, Groves, 1924 (2), p. 83, fig. 31 a.

L. liburnica, Stache, Pia, 1927, p. 89, fig. 72.

b) Primary rays of the fertile whorls one-jointed, cylindrical or funnel-shaped. Secondary rays simple, decidedly longer than the oogonia.

2) **L. nodulifera,** Stache, 1889.

L. nodulifera, Stache, l. c. p. 133, pl. 6, fig. 3.

3) **L. foliosa,** Stache, 1889.

L. foliosa, Stache, l. c. p. 133, pl. 4, fig. 10, 11.
Remarks: The neck of the oogonium of *L. foliosa* is longer and moere cylindrical than in *L. nodulifera.*

c) Primary rays of the fertile whorls one-jointed, cylindrical or funnel-shaped, Secondary rays forked or two-celled.

4) **L. symmetrica,** Stache, 1889.

L. symmetrica, Stache, l. c. p. 133, pl. 6, fig. 1 & 4.
L. symmetrica, Stache, Groves, 1924 (2), p. 83, fig. 31 b.
L. symmetrica, Stache, Pia, 1927, p. 89, fig. 72 r.

d) Primary rays of the fertile whorls more than one-jointed, oogonia apparently lateral.

5) **L. articulata,** Stache, 1889.

L. articulata, Stache, l. c. p. 133, pl. 6, fig. 2 & 5.

Nitella, Agardh, 1824.

NITELLA, Agardh, Systema Algarum, p. XXVII, 1824.

The largest genus of Charophyta, comprising more than 100 living species; distinguished from the section Chareae, by the coronula being 10-celled (5-celled in Chareae), the antheridia being terminal, and the oogonium longitudinally compressed. Neither the coronula nor the antheridium are preserved in the fossils so that the third character alone is available for discrimination.

With the exception of fruits found in the very recent deposits, belonging almost certainly to one or other of the two commonest of living European species, none of the fossil fruits appear, in a normal condition, to be longitudinally compressed. It is difficult therefore to understand on what ground the other species in the following list have been attributed to the genus.

Two species, Chara *(Nitella?) Boulleti,* „Braun ms." Unger, 1850, and *Chara (Nitella?) prisca,* Unger, 1850, of which the vegetative parts only were found, were queried for this genus on account of the ecorticate stem. They might however equally belong to the later-constituted genus Tolypella, or to the ecorticate-stemmed section of Chara. The author's reason for querying *Nitella* for *Chara (Nitella?) ovalis,* Fritzsche, 1924, is not apparent The particulars of these three species will be found under the genus *Chara.*

N. flexilis, Agardh, 1824 (Recent).

N. flexilis, Agardh, (Chara flexilis, Linn. ex parte), l. c. p. 124.
C. flexilis, Sternberg, 1825, p. XXXI, (1).
N. flexilis, „L.", Nathorst, 1891, p. 20 (2).
„*N.* typ. *flexilis*", Hartz, 1902, p. 64 (3).
N. flexilis, Ag. Brockm-Jerosch, 1910, p. 180 (4).
N. flexilis, Ag. Bertsch, 1931, p. 84 (5).

Remarks: A common living European species; except that the fruits are usually slightly larger, they are hardly distinguishable from those of the nearly related and equally common N. opaca, Agardh, so that possibly some of the records belong to the latter species.

All the records relate to very recent (Post Tertiary) deposits, no 1 „novissimus formationibus passim ..... ad Burgtonnam et Wimariam"; no. 2, glacial, Schleswig Holstein; no. 3 „sen glaciale", Denmark; no. 4, glacial delta Cant. St. Gallen, Switzerland; no. 5, Federseerieds, Wurtemberg.

? Nitella Cosinensis, Stache 1889.

Chara Cosinensis, Stache, 1880, p. 198, nomen nudum.
?Nitella (Chara) Cosinensis, Stache, Abhandl. Geol. Reichsanst. Wien, XIII, 1, p. 121, pl. 3, fig. 4—6, 1889.
Gyrogonites cosinensis, Pia, 1927, p. 89.

Remarks: The author's figures 4 & 5 represent the oospore which is nearly spherical, and shows 7—8 well-marked ridges. The oogonium is only represented by fig. 6, which purports to show a diagonal section, but, as 14 sections of spiral-cells are shown, there is evidently some mistake. No complete section of a charophyte fruit could show more than 5, or in the case of the most ancient type 6, spiral-cells. The diameter is given as 1000—1400 μ. The end-views of the oospores show them to be terete in section so the plant cannot belong to Nitella.

Occurrence: Lowest Tertiary, Liburnian, Cosina, near Triest, N. E. Italy.

? Nitella devestita, Stache, 1889.

?Nitella (Chara) devestita, Stache, Abhandl. Geol. Reichsanst. XIII, 1, p. 136, pl. 3, fig. 56 a b, 1889.
Gyrogonites devestitus, Pia, 1927, p. 89.

Remarks: In this case also the figures show the oospore, the spiral-cells being absent, but the outline of the oogonium is indicated by a line. No dimensions are given. The figure shows the oospore as broadly ellipsoid, with 7 well-marked ridges; the end-view shows it to be terete in transverse section.

Occurrence: Lowest Tertiary, Liburnian, Corgnale, near Triest, N. E. Italy.

? Nitella globulus, Stache, 1889.

?Nitella (Chara) globulus, Stache, Abhandl. Geol. Reichsanst. XIII, 1, p. 121, pl. 1a, fig. 16, 1889.
Gyrogonites globulus, Pia, 1927, p. 89.

Remarks: Fruit described as nearly spherical, up to 800 μ in diam. the spiral-cells showing 8 convolutions.

Occurrence: Lowest Tertiary, Liburnian, Cosina, near Triest, N. E. Italy.

? Nitella robusta, Stache, 1889.

Chara robusta, Stache, 1880, p. 199, *nomen nudum.*
?Nitella (Chara) robusta, Stache, Abhandl. Geol. Reichsanst. XIII, 1, p. 136, pl. 4, fig. 7, 1889.
Gyrogonites robustus, Pia, 1927, p. 90.

Remarks: Fruit described as 1500 μ long, 1200 μ broad, the spiral-cells showing 9 convolutions, and figured as shortly ellipsoid, with rounded extremities.

Occurrences: Lowest Tertiary, Liburnian, in the neighbourhood of Divacca, near Triest, N. E. Italy.

Nitella (Chara) Stacheana, „Ung.", Stache, 1889.
Chara Stacheana, Unger, 1860 (2), p. 3. pl. 1—4.
C. Stacheana, Ung., Schimper, 1869, p. 229.
Nitella (Chara) Stacheana, „Ung." Stache, Abhandl. Geol. Reichsanst. XIII, 1, p. 135, pl. 3, fig. 54, pl. 4, fig. 1, pl. 5, fig. 40.
Gyrogonites subimpressus, Pia, 1927, p. 90.
For particulars see under genus *Chara.*

Nitella subimpressa, Stache, 1889.
Nitella (Chara) subimpressa, Stache, Abhandl. Geol. Reichsanst. XIII, 1, p. 136, pl. 3, fig. 55, 1889.
Gyrogonites subimpressus, Pia, 1927, p. 90.
Remarks: Fruit described as 1300 μ long, 1100 μ broad, and figured as broadly globose-ellipsoid, the spiral-cells showing 9 convolutions the end-view proving it to be terete in transverse section.
Occurrence: Lowest Tertiary, Liburnian, in the neighbourhood of Triest, N. E. Italy.

Nitellopsis, Hy, 1889.

Nitellopsis, Hy, Bull. Soc. Bot. France, XXXVI, p. 397, 1889.
Tolypellopsis, Migula, 1890, Die Characeen, Vol. V, Rabenh. Krypt. Fl. Deutsch, p. 253.
A genus of living *Charophyta,* sect. *Chareae,* comprising one, or at most two, known species, distinguished from the genus *Chara,* by the absence of stipulodes.

N. obtusa, Groves, 1919.
Chara obtusa, Desv. 1810, in Loisel. Not. aj. Fl. France, p. 136.
C. stelligera, Reichenb., 1829, Mossl. Handb. Gewächse, ed. 2, III, p. 1595.
Nitellopsis obtusa, Groves, 1919, Journ. Bot. LVII, p 127.
Remarks: Specimens of oogonia, with contained oospores, collected by the late Clement Reid, were referred with little doubt, to this species by Groves (1924, p. 84) from their great resemblance to those of the living plant, which occurs in Norfolk.
Occurrence: Tertiary, Pliocene, Cromer Forest Bed, Sidestrand (Norfolk), England.

Palaeochara, Bell, 1922.

PALAEOCHARA, Bell. 1922, Trans. R. Soc. Canada, Ser. 3, XVI, Sect. 4, p. 160.
The distinctive character of this genus is that the oogonium has six spiral-cells, instead of five, as in all known Charophytes, living and fossil. Detached fruits only have been found. It is the earliest type which, in the opinion of the present writer, can with safety be attributed to the Charophyta.
Dr. Bell in his admirable paper (l. c.) gives the following particulars as to the conditions of preservation of the remains:
„The remains of the oogonium are now preserved as iron pyrites, inferred to be a pseudomorph after calcite. Thin sections examined under reflected light show the *Chara* affinities of the fossil in that the original investment consists of partial infillings of former spirally wound elongate cells. The position of the former walls of these cells is revealed in section either as oblique or transverse lines of parting, and in the surface view by narrow grooves on the spiral ridges. The latter appearance of the surface indicates that the original calcareous

deposit grew from initial deposition against the concave inner borders of the cells as in recent *Chara*. In recent Charas the lateral walls break down as the fruit matures, so that a continuous shell of lime finally surrounds the oospore. In *Palaeochara* the lateral walls evidently persisted to a greater extent. The interior of the oogonium is now filled with infiltrated calcite. The basal circular area from which the spirals spring is a sunken pit or foramen, and probably indicates the former position of the attachment of the stalk-cell. There is seemingly also a minute open pore and narrow slits between the cells at the apical end, since a specimen treated with dilute hydrochloric acid admits the acid to the interior with the consequent solution of the infiltrated calcite and ebullitions of gas through the neck. The neck, however, is wholly or partially broken off in the majority of specimens."

P. acadica, Bell, 1922.

P. acadica, Bell, l. c., p. 160, pl. 1, fig. 1—9.

P. acadica, Bell, Groves, 1924, in Gr. & Bull.-Webst. Brit. Char. II, p. 77, fig. 29.

P. acadica, Bell, Pia, 1927, p. 91.

Remarks: Dr. Bell gives (l. c.) the following description of the fruit:

„Oogonium subglobular to pear-shaped with hemispherical base and conical apex. Length somewhat exceeding the greatest diameter. Investing cells six in number, commencing around a smooth circular basal area and making one complete spiral turn to the raised conical end. Six or seven spiral ridges visible on a side view. Length o. 55 mm.; diam. o. 53 mm.; diam. of smooth basal area o. 075 mm."

Occurrence: Primary, Upper Carboniferous, Coal Measures, St. Rose Mine, Inverness County, Nova Scotia.

Tolypella, Leonh., 1863.

TOLYPELLA, Leonhardi in Lotos, XIII, p. 78 (1863).

This very distinct genus numbers about 15 living species. The oogonia are distinguished from those of *Nitella,* its nearest allied genus, in being terete instead of longitudinally flattened; from those of Chara, as now understood, in having a coronula of ten cells, instead of five. The absence of the coronula in the fossils renders it impossible to say with certainty whether or not the following species, which have been ascribed to it, really belong to the genus. The portions of the fruits that are preserved, however, bear so close a resemblance to some of the living species, that there is little doubt on the point. The terete fruit clearly separates them from *Nitella.* There is little difference between the fruits of the three fossil species, except in point of size. Those of numbers 2 and 3 are rather smaller than the fruits of *T. hispanica,* the smallest living species, but perhaps some allowance should be made for shrinkage in the fossils. Owing to the thinness of the lime-shell in all three species, the spiral-cells appear decidedly concave, as in the living species they most clearly resemble.

T. headonensis, Reid & Groves, 1921.

T. headonensis, Reid & Groves, Quart. Journ. Geol. Soc. LXXVII, 3, p. 188, pl. 6, fig. 2—3, 1921.

Remarks: Fruit very similar to that of the living species, T. prolifera, Leonh., c. 450—475 μ long, 400—425 μ broad, spiral-cells showing 9—10 convolutions, apparently somewhat tumid at the apex.

Occurrence: Tertiary, Lower Headon Beds, Hordle (Hants) England.

T. parvula, Read & Groves, 1921.

T. parvula, Reid & Groves, l. c., p. 188, pl. 6, fig. 4—5, 1921.

Remarks: Fruit subglobose-obovoid, c. 325—375 μ long, 225—275 μ broad, spiral-cells showing 10—11 convolutions.

Occurrence: Tertiary, Lower Headon Beds, Hordle (Hants), England.

Chara (Tolypella?) perpusilla, Groves, 1926.

C. (Tolypella ?) perpusilla, Groves, in Reid & Chandler, Brit. Mus. Cat. Cainoz (Bembridge Fl.) p. 173, fig. 20, 1926.

Remarks: Fruit extremely small, ellipsoid, c. 275—300 μ long, 200—250 μ broad, spiral-cells showing about 12 convolutions. Apparently the smallest Charophyte fruit known from the Tertiary.

Occurrence: Tertiary, Bembridge Beds, Whitecliff Bay (Isle of Wight), England.

Appendix.

Other fossil organisms which have been ascribed to the Charophyta or thought to be related to the group.

ALGITES, Seward, 1894, Cat. Mesoz. Pl. Brit. Mus. Weald. I, p. 4.

A provisional genus designed to include *Alga*-like remains of uncertain character.

Algites (Palaeonitella) Cranii, Kidston & Lang, 1921, Trans. Roy. Soc. Edinburgh, LII, 4, pp. 876—881 (with text-figures), pl. 8, fig. 91—97, pl. 9; Groves, 1924 (2), p. 76, fig. 28; Pia, 1927, p. 91, fig. 75.

The vegetative remains of this plant present some decided points of resemblance to those of the Charophyta, but so far no trace of reproductive organs exhibiting the distinctive characters of the group have been discovered, and until such are forthcoming its relationship must remain doubtfoul. The specimens have been obtained from the Old Red Sandstone, Muir of Rhynie (Aberdeenshire), Scotland.

ASTROCHARAS, Stache, 1872, Verh. Geol. Reichsanst. Wien, 1872, p. 316, nomen nudum.

No information is given by the author as to the characters upon which it was proposed to base this genus, nor as to the organisms to which it referred. Stache's specimens and drawings labelled *Astrochara* do not show any affinity to the *Charophyta.*

Mr. W. N. Edwards, having examined some of Stache's original specimens, has described and figured this plant (Ann. Mag. Nat. Hist. ser. 10, X, p. 213, pl. 10), under the name Hippuridella Stacheana, and suggests that it may belong to the Hippuridaceae.

Astrochara liburnica & A. Pisinensis, Stache, 1880, Verh. Geol. Reichsanst. Wien, no. 12, p. 201, *nomina nuda.*

Occurrence: Lowest Tertiary, Liburnian, Pisino, near Triest, N. E. Italy.

BARRANDEINA, Stur, 1881, Sitz. Akad. Wiss. Wien, LXXXIV, 1, p. 362.

Though placed by the author in „Ordo Characeae praecursiores" the plant he figures, *B. Dusliana,* (previously named *Protolepidodendron Duslianum,* Krejci), does not show the least resemblance to the Charophyta, being evidently of vascular construction.

CALCISPHAERA, Williamson, 1880, Phil. Trans. Roy. Soc. CLXXI, 2, p. 520.

A provisional genus designed to include ± spherical fossil bodies of uncertain affinity. To this the author assigned certain globose organisms with dextral spiral markings found in Ohio, U. S. A. to which he gave the name *C. robusta.* To a somewhat similar organism from the same state Knowlton (1889) gave the name of *C. Lemoni.* These bodies have also been named *Saccamina Eriana,* Dawson (1883) *Moellerina Greenei,* Ulrich (1886), *Trochiliscus Lemoni,* Karpinski (1905), and *T. robustus,* Karp. (1905). There is considerable difference of opinion as to the nature of the organisms in question. Several authors confidently ascribe them to the Rhizopoda. Some of the specimens certainly bear a strong superficial resemblance to the oogonia of Charophyta, but, if, as Dr. Bell concludes (1922), the spiral markings are merely on the exterior surface, and are not cylindrical cells, such as compose the outer portion of all known Charophyte fruits, the evidence is against their being members of the group, apart from the fact that the spiral markings are in the reverse direction to that of the spiral-cells, i. e. the coil is dextral instead of sinistral.

MOELLERINA, Ulrich. See *Calcisphaera.*

PALAEONITELLA, See Algites.

PALAEOXYRIS, Brongniart *(Spirangium,* Schimper). Nathorst (1879) has put forward the view that this extremely problematic organism may be related to the Charophyta, the spiral markings representing spiral-cells enveloping an oospore. Until however the internal structure can be investigated this can only be a matter of conjecture. In Nathorst's figures (l. c.) the spirals are shown as dextral. There is a strong probability that Palaeoxyris does not belong to the Vegetable Kingdom.

SACCAMINA, Dawson, See *Calcisphaera.*

SPIRANGIUM, Schimper, See *Palaeoxyris.*

SYCIDIUM, Sandberger. Karpinski (1905) includes the problematic organisms with longitudinal, and sometimes transverse, ribs to which this name has been given, in his group „Trochilisken", but judging from his own figures and those of Pia (1927), there seems no reason to suppose that they are related to the *Charophyta.*

TROCHILISCUS, Pander, See *Calcisphaera.*

Stratigraphical table of fossil remains of Charophyta.

So much uncertainty exists as to the relative age of, many of the deposits in which Charophyte-remains have been found, that it is not possible to draw up a complete table of their occurrence. The following must therefore be regarded merely as an attempt to indicate approximately the range in time, as far as is yet known, of the various types which have been described. In compiling this table, the writer has, in almost all cases, depended upon the work of others, especially on a list prepared by the late Clement Reid, on MM. Dollfus and Fritel's account of the species in the Paris Basin (1920) and on Prof. Pia's contribution to Hirmer's Paläobotanik (1927). Here, as throughout the Catalogue, Mr. W. N. Edwards's help has been invaluable.

Primary = Palaeozoic.

Carboniferous.	
Coal Measures of Nova Scotia.	Palaeochara acadica, Bell.

Secondary = Mesozoic.

Upper Triassic, or Rhaetic	
(Congo-Angola).	Chara Rauwi, Ler.
Jurassic.	
Oolitic.	
Bajocian. (Inferior Oolite)	Charae spp. (indet.).
Bathonian. (Forest Marble)	C. laevigata, Upton.
Oxfordian.	C. Bleicheri, Sap.
Kimmeridgian.	C. Gebhardi, Ottm.
Purbeckian.	C. Jaccardi, Heer.
"	C. Maillardi, Sap.
"	C. spp. (indet.).
"	Clavator Reidii, Grov.
? Jura-Cretaceous. (origin uncertain)	C. estanciana, Hann.
Cretaceous.	
Wealden.	C. Knowltoni, Sew.
"	C. medicaginula, Brong.
Upper Cretaceous.	C. polonica, Ung.
" "	C. Stantoni, Knowlt.
" "	C. Malcolmsonii, Sow.
Cretaceous of North America (horizon uncertain).	C. brewsterensis, Grov.
" " "	C. texensis, Grov.
Cretaceous of South America.	C. elliptica, Fritz.
" " "	C. ovalis, Fritz.

Tertiary = Cainozoic.

Liburnian.	
Chara Stacheana, Ung.	Lagynophora foliosa, St.
Cristatella doliolum, St.	L. liburnica, St.
Kosmogyra acanthica, St.	L. nodulifera, St.
K. cingulata, St.	L. symmetrica, St.
K. guttifera, St.	Nitella (Chara) cosinensis, St.
K. ornata, St.	N. (C.) devestita, St.
K. perarmata, St.	N. (C.) globulus, St.
K. superba, St.	N. (C.) robusta, St.
Kosmogyrella carinata, St.	N. (C.) subimpressa, St.
Lagynophora articulata, St.	
Eocene of America.	
Wasatch Group.	Chara compressa Knowl.
Midway Formation.	C. Gardnerae, Grov.
Eocene of Europe.	
Thanetian.	C. minima, Sap.
»	C. helicteres, Brongn.
»	C. sparnacensis, Wat.
Sparnacian.	C. helicteres, Brong.
»	C. Dutemplei, Wat.
»	C. onerata, Wat.
»	C. sparnacensis, Wat.
»	C. Brongniarti, Heb. (non Ung.)
»	C. torulosa, D. & F.
»	C. squarrosa, D. & F.
»	C. nielfalensis, D. & F.
Landenian.	C. sp.
Ypresian (London Clay).	C. medicaginula, Brongn.
Lutetian.	C. Archiaci, Wat.
»	C. Lemani, Brongn.
Auversian.	C. Archiaci, Wat.
»	C. Lemani, Brongn.
»	C. fyeensis, Crie.
»	C. crassa, D. & F.
Marinesian (or Bartonian).	C. Archiaci, Wat.
»	C. Lemani, Brongn.
»	C. tuberculata, Lyell.
»	C. crassa, D. & F.
»	C. elegans, D. & F.
»	C. fyeensis, Crié.
Ludian (Headon Beds).	C. distorta, R. & G.
C. helicteres, Brongn.	C. polita, R. & G.
? C. aragonensis, Ung.	C. strobilocarpa, R. & G.
C. Voltzii, Ung.	C. subcylindrica, R. & G.
C. siderolitica, Grep.	C. tornata, R. & G.
C. Wrightii, Salt.	C. turbinata, R. & G.
C. Grepini, Heer.	C. vasiformis, R. & G.
C. anaplotheriorum, Sap.	Tolypella headonensis, R. & G.
C. caelata, R. & G.	T. parvula, R. & G.
Ludian (Osborne Beds).	C. Lyelli Ung.
Eocene of Hungary.	Characeites verrucosa, Tuz.
» »	C. globosa, Tuz.
» »	C. acuminata, Tuz.
Oligocene.	
Sannoisian.	C. elegans, Dollf. & Frit.
»	C. Oehlerti, Dollf.
»	C. Tournoueri, Dollf.
»	C. petrolei, Andr.

Sannoisian.	C. variabilis, Andr.
„ (Bembridge Beds)	C. medicaginula, Brongn.
„ „ „	C. tuberculata, Lyell.
„ „ „	C. Lyelli, Ung.
„ „ „	C. vasiformis, Reid & Gr.
„ „ „	C. subglobosa, Grov.
„ „ „	C. vectensis, Grov.
„ „ „	C. vespiformis, Grov.
„ „ „	Tolypella perpusilla, Grov.
„ (Hamstead Beds)	C. helicteres, Brongn.
„ „ „	C. tuberculata, Lyell.
„ „ „	C. Escheri, Ung.
„ „ „	Tolypellae spp.
Firmitian.	C. medicaginula, Brongn.
„	C. Brongniarti, Ung.
„	C. depressa, Wat.
Tongrian.	C. Lyelli, Ung.
„	C. Salteri, Bosq.
Stampian.	C. gypsorum, Sap.
Chattian.	C. Langeri, Ett.
„	C. Ungeri, Ett.
„	C. Meriani, Ung.
? division.	C. subdestructa, Fliche.
Miocene.	
Aquitanian.	C. Boulleti, Ung.
„	C. Escheri, Ung.
„	C. inconspicua, Ung.
„	C. Meriani, Ung.
„	C. prisca, Ung.
„	C. Rollei, Ung.
„	C. Sadleri, Ung.
„	C. Schubleri, Ung.
„	C. stiriaca, Ung.
„	C. Zietheni, Ung.
„	C. granulifera, Heer.
„	C. Rochettiana, Heer.
„	C. latiuscula, Sap.
Burdigalian & Helvetian	? C. Escheri, Ung.
„ „	? C. Bernoullii, Ung.
„ „	? C. Reussiana, Ett.
Tortonian (Oeningen Beds)	C. Blassiana, Heer.
„ „	C. dubia, Ung.
„ „	C. Zolleriana, Heer.
?„Miocène Inférieur". Vallée de Sault.	C. destructa, Sap.
Miocene, „Cyprisschiefer Nord-Böhmens"	C. neogenica, Engel.
Miocene of N. America (Florissant Beds)	C. peritula, Cocker.
Miocene of Hayti.	C. Woodringi, Berry.
Pliocene.	
Plaisancian.	C. Zoberbieri, Fritsch.
Cromerian.	? C. connivens, Braun.
„	Nitellopsis obtusa, Grov.

Quaternary.

Pleistocene of New Mexico.	C. Springerae, Knowlt.
Holocene.	

A number of Charophyte-remains have been reported from various recent deposits, all of which probably belong to living species.

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Gen. Nov.: Kosmogyra, Kosmogyrella, Cristatella.
Sp. nov.: Lagynophora articulata, L. foliosa, L. nodulifera, L. symmetrica, Cristatella doliolum, Kosmogyra acanthica, K. cingulata, K. guttifera, K. ornata, K. perarmata, K. superba, ?Kosmogyrella carinata, Nitella Cosinensis, N. subimpressa, ?N. globulus, ?N. devestita, ?N. robusta.
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